The Science of Health

With respect, gratitude, and

deep affection,

this book is dedicated to

HELEN WRIGHT

Preface to the Second Edition

This volume is for use in those hygiene courses where the time allotted for presentation is brief but where a comprehensive evaluation of the value of personal and public hygiene is desired. It is no small task to encompass in a short book, for a short course, the health situation; the structure of the human body; the maintenance of personal, physical, and mental health; the application of personal to community hygiene; and the relation of the individual to future generations. To aid *teachers* to present hygiene briefly yet in a manner befitting a scientific subject in a college curriculum, and to aid *students* to gain respect for, interest in, and profit from, such study—these have been the author's objectives.

The shortness of semester courses, in proportion to the extent of the subject, should be a stimulus to teachers. Even by means of isolated lectures and classroom discussions of important topics much may be accomplished, but still more, if a comprehensive textbook be used as a background. In fact, the shorter the course, the more a textbook appears to be needed to give coherence to the course.

The author has made a special effort to do the following:

1. To give *facts usable by the student in making his own decisions* in whatever circumstances he finds himself, not to give precepts unsupported by facts nor precepts applicable only in ideal circumstances.

2. To give *opinions generally held by medical science,* not individual opinions.

3. To *weight the material properly,* giving each subject an amount of space in proportion to its importance.

4. To *arrange the material so that its order and sequence in itself will be educational in effect.* A textbook should present a panoramic view of the whole terrain in order that "close-ups" shall not give a distorted impression.

5. To *use scientific terminology in so far as it will help to clarify the student's thinking*. That correct verbal symbolization is an aid to clear thinking appears to be well established.

The author is grateful to Dr. James B. Lackey, Science Editor of The Blakiston Company, for the final check of the manuscript, with the making of any necessary changes in scientific facts, statistical figures, and illustrations; the reading of the proof; and the preparation of the index and bibliography.

FLORENCE L. MEREDITH

TUFTS COLLEGE,
October 1950

Acknowledgments

The illustrations listed herewith are borrowed from other books published by The Blakiston Company:

Bachmann and Bliss: "Essentials of Physiology and Pharmacodynamics," pages 41, 97, 139, 143 *bottom,* 402.

Bremer-Weatherford: "Text-Book of Histology," page 20.

Broomell and Fischelis: "Mouth and Teeth," page 190.

Bundy-Weeder: "Anatomy and Physiology," pages 36, 40, 204.

Evans: "Recent Advances in Physiology," page 165.

Halliburton: "Handbook of Physiology," pages 30, 32, 91 *left,* 277, 403.

Kingsley: "Comparative Anatomy of Vertebrates," page 34 *top, left.*

Lambert-Dawson: "Histology—An Introduction and Guide," page 57.

Meredith: "Health of Youth," page 215.

Meredith: "Hygiene," pages 23, 25, 45 *left,* 133, 134, 250, 268, 273, 417.

Miller: "Oral Diagnosis and Treatment," page 78.

Neal and Rand: "Chordate Anatomy," pages 34 *top, center and right,* 34 *bottom,* 39, 163.

Patten: "Embryology of the Pig," page 191.

Patten: "Human Embryology," page 408.

Schaeffer: "Morris' Human Anatomy," pages 26, 35, 44, 122, 146, 299, 317 *bottom,* 410.

Schmalhausen: "Factors of Evolution," page 418.

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Part 1

Introduction

1

The National Health Situation

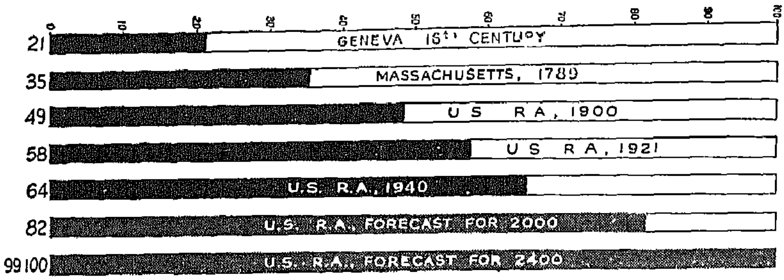
Present and Future Health Levels. Vital statistics, the statistics concerning human life, give abundant evidence that in this country men and women live longer than in any comparable country in the world and that they enjoy better health. Furthermore, statistics show that there has been a steady increase in the level of health and in the average length of life. Gratifying as these data are, they must be placed alongside other data which indicate that we have not yet reached the level of health nor the length of life we might expect to reach. There still are far too many people who are not well and far too many who "die before their time." In this volume will be discussed the important reasons why our national health has advanced to the present high level and the important ways by which further advances can be made, especially with reference to individual efforts.

Length of Life

Life Expectancy. The term expectancy of life means the number of years a person of a given age can be expected to live. The figures are derived by statistical methods from records of birth and death. Life expectancy at birth is equivalent to average length of life. The latter term does not mean the average age at death but the average age that will be attained by children born in a given year.

It is possible to make life tables and to compute life expectancy for specific classes of people, according to age, sex, or any other factors. Specific rates may differ markedly from general rates. For example, life expectancy for females is greater at all ages than for males.

Life Expectancy in the United States. In Table 1 is shown life expectancy for white and Negro persons (total, males and females) from 5 to 70 years. All these figures have greatly increased since vital statistics



Average length of life in past and present, and forecast of length of life in United States if present rate of increase continues. (R. A., Registration Area, which now includes all States.)

were first gathered. The increase in average length of life (i.e., in life expectancy at birth) is shown above.

Table 1

EXPECTATION OF LIFE BY RACE AND SEX IN UNITED STATES, 1948[1]
(RATE PER 1,000)

Age	*Total Persons*	*White*		*Negro*	
		Male	*Female*	*Male*	*Female*
5	64.82	62.33	67.57	59.49	61.93
10	60.00	57.52	62.72	54 75	57.10
15	55.15	52 69	57.83	49.99	52.34
20	50.39	47.97	52.98	45.43	47.77
25	45.69	43.31	48.17	41.04	43.34
30	41.02	38.64	43.41	36.72	38.95
35	36.39	34.03	38.69	32.42	34.62
40	31.90	29.58	34.06	28.23	30.44
45	27.59	25.38	29.57	24.32	26.44
50	23.51	21.46	25.25	20.69	22.69
55	19.67	17.87	21.12	17.36	19.18
60	16.09	14.61	17.24	14.34	15.92
65	12.83	11.68	13.67	11.65	12.98
70	9.93	9.11	10.52	9.30	10.44

[1] *Statistical Bulletin*, 1949.

It should be noted, however, that the increase among older persons has not been so great as among younger. Those who have reached 50 years of age in 1950 can expect to live less than a year longer than those who reached that age 90 years ago. This brings up the question whether there is a natural limit to length of life.

For each variety of living creature there appears to be a natural life span or length of life that could be attained if all went well and that

could not be lengthened by any means whatever. Living things seem to be "wound up" to run just about so long, like the eight-day clock. The question is how long can man be expected to "run."

The Psalmist's statement that the days of man's years are three score years and ten has become tradition, in spite of the fact that the book of Genesis records that God stated of man, "His days shall be an hundred and twenty years." We know that many persons live beyond 70, but statisticians report that it is unusual for human beings to reach 100 years of age. One of the leading authorities says that he knows of several authentic cases of life to 106 years but none beyond that age.

Biologists find support for the theory that man's natural life span is actually about 106 years. With many living creatures total length of life is five times as long as it takes the skeleton to attain full growth. In man this takes about 21 years. According to this reckoning, man's life span would be not far from the oldest authenticated age. Statistics based on the progressive increase in length of life also bear out that theory. At the present rate of increase the average length of life might be 100 years by A.D. 2400.

In experimental work with animals, however, biologists have recently obtained results that arouse question as to whether there is a "natural" life span. For example, McCay of Cornell in 1938 reported that he and his associates had been able to cause rats to live 1000 days instead of their usual 600 days by feeding them a low-calorie diet. Furthermore, the rats remained young in appearance during their long lives. He says, "The life span is flexible, and the extent to which it can be increased is unknown." Professor Irving Fisher of Yale has suggested that we should not consider length of life fixed, but should consider it in terms of "chance of survivorship, which diminishes indefinitely, but with no known or knowable limit."

What Is Senility? Senility is a biologic state in which the organism becomes old. It is not a matter of chronologic age. A person begins to age as soon as he is born, and evidence of senility may appear in the forties or even before.

Senility is characterized by numerous degenerative changes in organs. In the normal aging process this occurs more or less simultaneously in all organs, but in premature senility it occurs often in some organs more conspicuously than in others (e.g., heart, arteries, brain, kidneys).

The causes of aging have been the subject of keen scientific interest for the past century. Theories that have been advanced are: that the

first step is hardening of the arteries whereby circulation everywhere is impaired; that deficiency of thyroid secretion initiates aging; and that aging starts when the sex glands begin to fail. In modern times it is believed that a wide variety of faulty conditions may cause aging. As stated, nutritional factors are receiving special attention, and it now appears that these may be fundamental to all others.

Geneticists assert that longevity, the ability to attain a really old age, is a hereditary factor and that a long life for some is impossible. Of course, in the cases of persons dying from causes other than senility normal length of life is impossible of determination. In a family that appears to be short-lived, the explanation may be not hereditary but acquired conditions that prevented individuals from living out the hereditarily possible life span. Conversely, an apparent hereditary longevity may be good fortune (or good technic) in escaping the various injurious agents such as bacteria, mechanical injury, chemical injury, malnutrition, and the like.

Mortality Rates

Mortality Rate Computation. In every city and town an official keeps records filed by each physician regarding the deaths in his jurisdiction. From these files local death rates are computed (by age, sex, and cause of death according to an international list). Local data are sent to state and federal offices, from which state and national figures are obtained. Unless otherwise stated, the death rate means the number of deaths per thousand population. In 1945 it was 10.5 in the United States. In 1870 it was 19.

Table 2

MORTALITY RATES PER 1,000 AT SPECIFIED AGES FOR TOTAL PERSONS, WHITE AND NEGRO, UNITED STATES, 1948*

Age and Sex	*1948*	*Age and Sex*	*1948*
Under 1 year	34.8	25–44 years	2.9
male	39.3	male	3.5
female	30.1	female	2.4
1–14 years	1.0	45–64 years	13.6
male	1.1	male	17.1
female	0.8	female	10.1
15–24 years	1.5	65 years and over	66.7
male	1.9	male	74.0
female	1.1	female	60.1

* Based on returns of a 10 per cent sample of death certificates received in state vital statistics offices for the 12 months of 1948.

Specific death rates include additional factors. For example, the infant mortality rate is computed as follows:

$$\frac{\text{Number of deaths under 1 year} \times 1000}{\text{Number of live births}} \quad \text{Deaths under 1 year per thousand live births}$$

Chief Causes of Death in the United States. The 10 leading causes of death in the United States according to the most recent census reports are shown in Table 3. It will be noted that the vast majority of deaths

Table 3

THE TEN LEADING CAUSES OF DEATH IN THE UNITED STATES IN 1948*
(RATE PER 100,000)

Heart disease	324
Cancer	133.8
Intracranial lesions of vascular origin, arteriosclerosis, and idiopathic high blood pressure	109.2
Nephritis	52.4
Accidents	45.0
Pneumonia	34.6
Tuberculosis	30.2
Premature birth	27.2
Diabetes mellitus	26.8
Motor accidents	22.8

* Reported by the Federal Security Agency, Public Health Service, National Office of Vital Statistics.

are from chronic disease. The fatal acute diseases are chiefly infections. Accidents and the diseases peculiar to and dependent upon infancy account for most of the others.

There has been a decline in mortality rates which is traceable to three factors. First, the ratio of deaths from acute and chronic diseases has been reversed. Indeed, many acute infections formerly prevalent and fatal have dropped from the list of major causes of death, and others have markedly decreased because of better control and prevention of infectious disease. (See Table 4.)

Second, among the diseases formerly ranking high as causes of death and which still do so, the rank has changed. Note, for example, that

Table 4

LEADING CAUSES OF DEATH, ACCORDING TO RANK, IN MASSACHUSETTS, 1858–1860, AND THE RANK OF THOSE STILL AMONG THE FIRST TEN IN THAT STATE AND THE UNITED STATES IN 1948

(FORMER AND PRESENT CAUSES OF DEATH)

	Rank, 1856–1860 Massachusetts	Rank, 1948 United States
Tuberculosis	1	7
Diarrhea and enteritis	2	
Diseases of infancy	3	
Scarlet fever	4	
Pneumonia	5	6
Old age	6	
Typhus	7	
Accidents	8	5
Heart disease	9	1
Diphtheria	10	

tuberculosis, although still ranking in the first 10, is not now at the top of the list but has dropped to the seventh place.

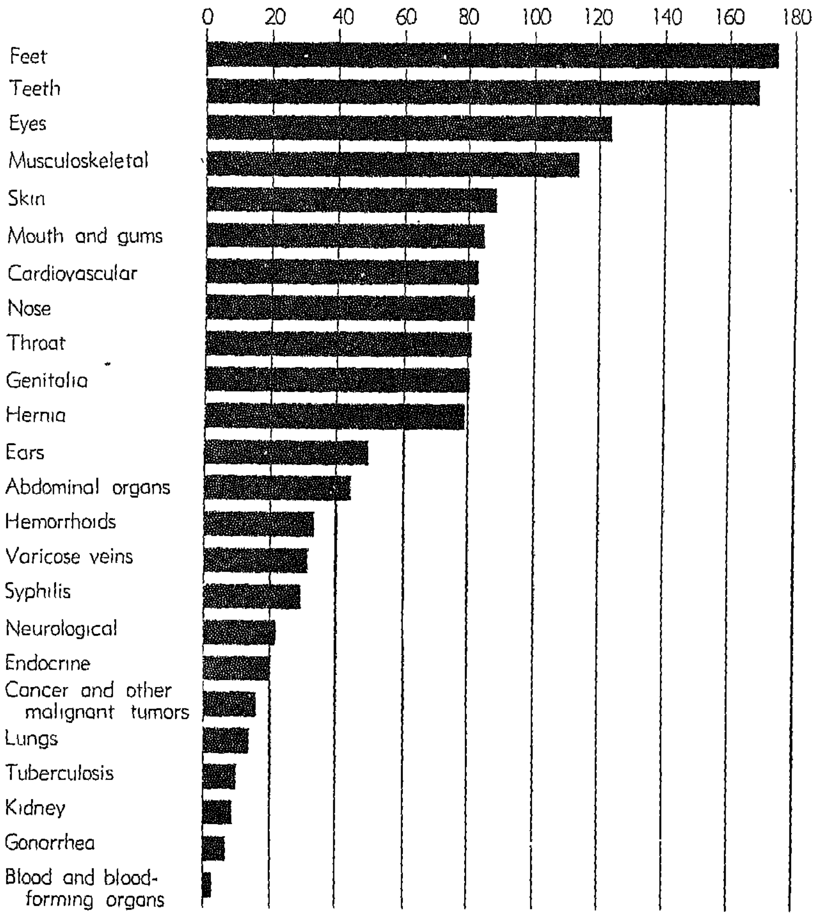
Third, several diseases not formerly causing a high death rate now rank in the first 10. As will be noted, cancer, cerebral hemorrhage, arteriosclerosis, nephritis, and diabetes do not appear among the leading causes of death 90 years ago. Possibly part of the statistical increase results from better ability to diagnose these diseases today. For example, conditions diagnosed formerly as old age might now be more specifically diagnosed as arterial, heart, or kidney disease. Nevertheless, it is believed that an actual increase has occurred in the maladies mentioned. This is thought to be at least partly, if not wholly, due to the fact that more people reach the age in which the incidence of these diseases is highest.

Morbidity Rates

Important as the death rates are as a measure of our national health, the truest measure is the amount of sickness and disability. Whatever the fatality rate of a disease (i.e., percentage who die of it), a disease is important if it impairs fitness. Therefore, the occurrence of many diseases is reported by physicians to some agency.

Sources of Data Regarding Sickness. Only one class of diseases, the specific communicable diseases, must be reported to government agencies. Figures are, however, obtainable on other sickness from many sources, such as the Army, the Navy, insurance companies, public and private schools and colleges, fraternal orders and mutual benefit societies, industrial plants, banks, stores, etc., and, of course, hospitals, dispensaries, clinics, sanitoriums, and private physicians.

Also, information has been obtained through numerous sickness surveys and censuses. The most important of these was the National Health Survey of 1935–1936, carried out by the United States Public Health



Major diseases and defects of 2,000,000 Selective Service registrants. November 1940–September 1941. (Rates in thousands.)

Service. It covered 83 cities and 23 rural areas in 19 states. In all, 800,000 families (representing 2,800,000 individuals) were interviewed during the winter season from November to March.

Frequency of Disability. The National Health Survey revealed that on the day interviewed one person out of 40 at ages 15 to 24 was disabled and that above and below this age group the rate was twice as high.

If the same rates prevail throughout the whole country, over six million persons are disabled (kept from work or school) on any given day, by the following causes:

1,500,000, by acute (brief) infections of the respiratory tract (colds, influenza, grippe, pneumonia, tonsillitis, etc.).
2,500,000, by chronic (lasting) illnesses such as those listed in Table 4.
500,000, by injuries due to accidents.
250,000, by the acute specific diseases often called "children's diseases."
250,000, by diseases of the stomach, liver, and appendix.
1,000,000, by miscellaneous acute conditions.

Chief Disabling Chronic Diseases. The chronic diseases most often found by the survey just mentioned are shown in Table 3. The list does not include several diseases about which it was thought that accurate information could not be obtained. For example, syphilis and alcoholism are not included, but it is thought that they should be near the top of the list. Similarly, malaria and hookworm disease, although not mentioned, belong on this list but not as high as formerly. These and other disabling ailments not reported by name occurred at the rate of 5,000,000 cases for the general population.

It will be noted that some of the diseases important as causes of death are also important as chronic diseases causing prolonged disability. This is often true of diseases of the heart, arteries, and kidneys and of cancer. However, the disease most often responsible for disability—chronic rheumatism—causes only a few deaths, less than two per hundred thousand annually.

Defects and Diseases Most Prevalent in Youth. Figures from the draft examinations have been most enlightening on this matter. They conform in a general way with findings from many other sources. Nearly 50 per cent of men in the first group examined for selective service were found not physically and mentally fit for general military service, and more than a third of these were found not fit for any form of duty. The principal causes of rejection by local boards and Army induction stations have been, besides faulty height or weight, as shown in the graph on p. 9.

Health Rates

Health Defined. Health may be defined, not in negative terms as absence of illness, but in positive terms, as a state in which the body is ready to act, in all its functions fully and freely and comfortably, in response to reasonable demands and, having acted, is able to restore itself promptly to its resting state and to renew itself for further action. A state of health normally is accompanied by a pervasive sense of well-being known as euphoria. Anyone who has experienced it knows that it is quite different from mere absence of discomfort. It may even be present during normal "healthy" fatigue.

How Many People Are Well? The usual method of arriving at the number of well people in a group is to subtract the number of the sick. By this process of exclusion, the vast proportion of our population falls into the class of the well.

Biologically, health is the positive state and disease the negative one. Actually, what we shall do to arrive at the ratio of well to ill is to count the well people in a group and subtract that number from the total to arrive at the number of the sick.

For obvious reasons, we must usually compute it the other way around, but we should bear in mind that being statistically well is not the same as being biologically well. A statistically well person is one who is not sick enough to count in the sickness records. A biologically well person is not sick at all.

It appears that in large groups of unselected individuals there will be some, perhaps 10 per cent, who are virtually well—persons who can count upon their health, barring accidental happenings; who will be ready for anything they may wish to do and able to do it with ease; who, in a word, "enjoy good health." In them there will be no demonstrable evidence that this happy state of affairs will not continue—again, barring accidents of disease or injury.

Submaximum Health. At the bottom of the list of those who are not well is the relatively small number who are actually ill and disabled in the common sense of these terms. As shown by the Health Survey, the total is perhaps 5 per cent of the population, with another 5 per cent in a condition in which they should not work. Between these two extremes are those (80 per cent) who are neither really well nor frankly sick. They are unfitted for the fullest and most efficient activity for their own satisfaction and for service. The majority of rejected draftees belong

in this group—not ill according to common standards but not well enough to serve their country in time of greatest need.

Can Fitness Be Increased? Submaximum health appears to be due sometimes to a constitutional inferiority. Not everyone is born to be well; not everyone has an equally good inheritance. Also, not everyone has the same care in infancy and childhood; conditions early in life may undermine the organism's stamina and make real health impossible.

With these exceptions, large numbers of people could move from the group of the somewhat unfit to the group of the wholly fit. This has been proved clinically time and again in the experience of all physicians.

It appears that as a nation our level of fitness has increased, but there is still a long way to go before all children gain their maximum of health and as adults retain it—a long way to go before we learn to live so as to have the sort of health that will "add years to the life, and life to the years."

Forces for Health

Whatever improvements in health have occurred in the past and will occur in the future, they are all due to two forces for health maintenance available to mankind. These are personal care of health and medical service.

Hygiene and Medical Service. Personal care of health means the daily practice of physical and mental hygiene. Included, of course, is the care given to the young by their parents before the time when the individual can assume responsibility for his own health care.

Two important phases of hygiene are (1) forming of good habits to act automatically in frequently recurring situations, and (2) gaining knowledge of how the body is constructed and does its work. This knowledge should be applied to the new situations adults must meet when old habits do not cover the situation and must be supplemented by thoughtfully chosen adaptive responses.

Care by physicians is to be obtained (1) whenever the health is in any way out of order and (2), during health, for the purpose of obtaining health guidance. The tremendous development of medical sciences and allied sciences in recent years makes available a vast amount of knowledge which the medical profession can apply both to keeping people well and getting them well.

The individual who makes use of medical science by having regular

physical examinations and by seeing a doctor promptly when ill is giving himself a chance to receive all the benefits medical science now can offer. There is every reason to believe that if all of us received these benefits the improvement in the nation's health would be astounding.

The Science of Medicine. Medicine is the science of preserving health and treating disease. It comprises all the wisdom that any science has to offer on these subjects. It uses all available scientific methods.

(The noun medicine and the adjective medical refer to the science of medicine, as stated. Also, the same noun and adjective are used in another sense, referring to a chemical or drug used to treat disease. Confusion sometimes arises over these two uses of the term medicine. For example, surgery is not medical treatment in the latter sense but is medical in the former, and truer, sense of the word.)

Those who practice medicine are graduates of medical schools, have the degree Doctor of Medicine (M.D.), and, after examination, are licensed by the separate states to practice medicine in all its branches. They are called physicians or, simply, doctors. Among them are general practitioners and specialists.

Practically all public libraries have on the reference shelf the "American Medical Directory," the directory of their own state medical association, and the "Directory of Medical Specialists." All genuine physicians will be listed in the first two and nearly all genuine specialists in the last.

Cults. Cults are "healing arts" that are not scientific; they comprise only part of the truth or none; and they use only a few methods or only one, none based upon the whole truth.

Those who practice cults are not trained, scientific physicians. They bear various names according to the cults they practice. Sometimes they are doctors of this or that, but not of medicine. The worst of these are called quacks, but there is little real difference between the numerous nonmedical "healing arts," since they all lack the foundation of medical science.

Just as one would not employ a person who was not an electrical engineer to manage and supervise an electrical power plant, logically one would not employ a person who is not a scientific "body engineer" to have anything to do with one's personal power plant. Those who are acquainted with the various fields of science do not make either mistake.

Medical Specialists. (Physicians practicing medicine are of two sorts—general practitioners and specialists. Technically, the former do not limit their practice and the latter do. Actually, many general practitioners do limit their practices some-

what and refer all their surgical cases to surgeons and many other types of cases to appropriate specialists. This is particularly true in districts where specialists abound.)

Specialists are physicians who have had a general medical education and thereafter have spent several years in intensive study of one special branch of medicine. Their special experience has been obtained by further hospital residence, by extensive clinical work in hospitals, by association in private practice with a recognized specialist, or by all three methods.

After being properly qualified, the physician may pass examinations given by the appropriate Board of Examiners and become certified as a specialist in that branch. The Boards are nongovernment agencies composed of specialists highly qualified to pass upon applicants for certification.

In this country there are 15 boards certifying 19 kinds of specialists, as follows:

INTERNAL MEDICINE. Disorders of the internal organs (heart, lungs, digestive organs, endocrine glands, etc., but exclusive of organs subject to other specialization).

ALLERGY. Disorders due to allergens.

CARDIOLOGY. Cardiovascular disease (heart and arteries).

GASTROENTEROLOGY. Disorders of the stomach and intestines, and of the associated organs of digestion.

TUBERCULOSIS.

SURGERY. Operative or manual procedures for treating disease.

ANESTHESIOLOGY. Anesthetics and their administration.

PLASTIC SURGERY. Surgery done to reconstruct injured or diseased areas so as to restore normal form and function.

PROCTOLOGY. Surgery and diseases of the rectum.

ORTHOPEDIC SURGERY. Surgery and diseases of the bones, joints, and other skeletal structures.

NEUROLOGICAL SURGERY. Surgical treatment of the nervous system.

OBSTETRICS AND GYNECOLOGY. The obstetrician deals with the care of women during pregnancy and at childbirth. The gynecologist deals with disorders of the female reproductive organs.

UROLOGY. Disorders of the urinary tract. (The genitourinary specialist also deals with disorders of the male genital organs.)

RADIOLOGY. The use of radiant energy, especially the use of x-rays in diagnosis and of radium and x-rays in treatment.

PEDIATRICS. The care of infants and young children in health and sickness.

DERMATOLOGY AND SYPHILOLOGY. The skin and the disease syphilis, respectively.

PSYCHIATRY AND NEUROLOGY. The mind and the nervous system, respectively.

PATHOLOGY. The science dealing with gross and microscopic changes of structure in tissues and organs and changes of function, as a result of disease. The clinical work of the pathologist is important in diagnosis and prognosis.

OTOLARYNGOLOGY. Literally, the science dealing with the ear (otology) and the

larynx (laryngology). Clinically, i...lso includes all the other structures of the upper air passages (nose, sinuses, pharynx, tonsils).

PUBLIC HEA...H WORK

Organized work carried out by groups provide conditions favorable for the health of a group and the indivi...'s composing it is called public health work. Such work is called offici... when done by government agencies—health departments of cities and ...ns, counties and states; the Federal Public Health Service; and certai... ...tions of other federal agencies.

Important phases of such work are sanitation (such as th... ...fication of public water supplies, disposal of sewage, work to insure milk and pure food); epidemiologic work, making use of numerous ... to control the spread of epidemic diseases; and work for infant ... maternal health.

Special kinds of health work are done by nonofficial organizations such as the American Red Cross, the National Tuberculosis Association, the American Cancer Society, and others mentioned in the following section.

Up to the present time, the greatest advances in health have come about through public health work, by methods that protect the health of large numbers of people. Still further advances along these lines can be expected, especially if individual citizens gain increasing knowledge of what is being done and what could be done through their government agencies, if they are willing to be taxed for this purpose and to coöperate in making it effective.

Certain phases of public health work are touched upon briefly in this volume, but the student should consult texts on this subject to obtain an adequate picture of the scope and value of this work.

Brief List of National Organizations Working Wholly or Partly for Health (Exclusive of Government Organizations and of Physicians' Professional Organizations)

American Association of Medical Social Workers,† 84 Rush St., Chicago, Ill.

American Cancer Society, 1250 Sixth Ave., New York City 20, N. Y.

American Child Health Association, 50 W. 50th St., New York City 20, N. Y.

† Associate member of National Health Council.

American Committee on Maternal Care, 5848 Drexel Blvd. South, Chicago 37, Ill.

American Dental Association, 212 E. Superior St., Chicago 11, Ill.

American Diabetes Association,† 1790 Broadway, New York City 19, N. Y.

*American Epilepsy League,** 50 State St., Boston, Mass.

American Foundation for the Blind, 15 W. 16th St., New York City 11, N. Y.

American Foundation for Mental Hygiene, 1790 Broadway, New York City 19, N. Y.

*American Heart Association,** 1790 Broadway, New York City 19, N. Y.

American Home Economics Association, 620 Mills Bldg., Washington, D.C.

American Hospital Association, 18 E. Division St., Chicago 10, Ill.

American Institute for the Deaf-Blind, 2332 Bryant Ave., Evanston, Ill.

*American National Red Cross,** Washington, D.C.

American Nurses' Association,† 1790 Broadway, New York City 19, N. Y.

American Occupational Therapy Association, 175 Fifth Ave., New York City 10, N. Y.

*American Public Health Association,** 1790 Broadway, New York City 19, N. Y.

*American Social Hygiene Association,** 1790 Broadway, New York City 19, N. Y.

*American Society for the Hard of Hearing,** 1537—35th St. N.W., Washington, D.C.

American Student Health Association, Minneapolis, Minn.

Child Welfare League of America, 130 E. 22nd St., New York City 10, N. Y.

Commonwealth Fund, 41 E. 57th St., New York City 22, N. Y.

*Maternity Center Association,** 1 E. 57th St., New York City 22, N. Y.

*National Committee for Mental Hygiene,** 1790 Broadway, New York City 19, N. Y.

National Council for the Physically Handicapped, 2102 W. Pierce St., Milwaukee 12, Wis.

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† Associate member of National Health Council.

* Active member of National Health Council.

National Foundation for Infantile Paralysis, 120 Broadway, New York City 5, N. Y.

*National Organization for Public Health Nursing,** 1790 Broadway, New York City 19, N. Y.

National Recreation Association, 315 Fourth Ave., New York City 10, N. Y.

National Research Council, Washington, D.C.

*National Safety Council,** 20 N. Wacker Drive, Chicago 6, Ill.

*National Society for the Prevention of Blindness,** 1790 Broadway, New York City 19, N. Y.

*National Tuberculosis Association,** 1790 Broadway, New York City 19, N. Y.

Rockefeller Foundation, 49 W. 49th St., New York City 20, N. Y.

The National Health Council, organized to avoid duplication of effort in national organizations, includes the organizations starred in this list, the Conference of State and Provincial Health Authorities of North America, and the National Committee of Health Council Executives; the associate members marked †; and two advisory members, the United States Public Health Service and the United States Children's Bureau. It maintains an information service and library at 1790 Broadway, New York City 19, N. Y.

* Active member of National Health Council.

2

The Body Itself

Cells, Tissues, Organs, and Systems

The architecture of the body is shown on p. 25, the skeleton, and on p. 19, some of the body cavities. The three cavities of the trunk are shown to be the *thorax,* or chest, the *abdomen,* and the *pelvis.* The diaphragm muscle separates the thorax from the abdomen. The abdomen is continuous with the pelvis. Some of the organs of the trunk are shown on p. 23.

The body is composed of several kinds of tissue or fabric (e.g., muscle, bone, fat, etc.). Some of these tissues are the proper tissue of a part (e.g., muscle tissue in muscles), and others are supporting fabrics, serving to give firmness and support to other tissues (e.g., fibrous tissue surrounding muscles).

Several fluids are constantly present in the body: (1) the blood, 6 to 7 quarts, contained in the blood vessels and in the heart; (2) the cerebrospinal fluid, in spaces (ventricles) within the brain, in the canal through the spinal cord, and between these organs and their covering membranes; (3) the tissue fluid, lying free within the tissues between cells; (4) tissue fluid or lymph, in drainage tubes called lymphatic vessels; and the fluids (5) within the eyeball, (6) in the inner ear, and (7) in various locations in small amounts between two layers of tissue which move on each other (as in joints, between the two coverings of the heart and of the lungs, etc.).

The Microscopic Units of the Body. All the body tissues are made up of minute units called cells. Cells are made up of a living, enclosing membrane, an inner viscous semifluid material called protoplasm which is also alive and is itself divided into a working portion, or cytoplasm, and a controlling portion, the nucleus. They vary greatly in shape, size,

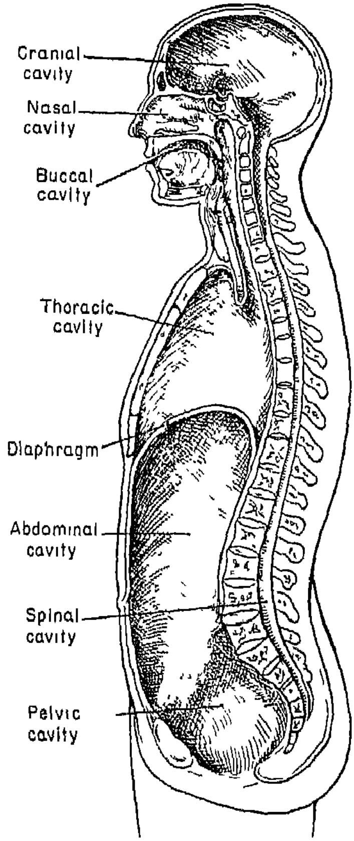
and general make-up. There is also a varying amount of intercellular substance, such as the solid part of bone, the fibers in tendons, etc.

These millions of cells are not only the structural but also the functional units of the body. It is because they live that the body lives.

In principle, body cells live much the same life as do the single-celled organisms living individual lives (e.g., bacteria); they take in nourishment and oxygen, excrete waste, and reproduce their kind.

Body cells obtain their nourishment and oxygen from the blood and return their waste to it. They reproduce during the growing period of life, and some of them reproduce when necessary to repair body injuries.

Not all body cells are alike, however, nor do they live precisely the same lives. Some are organized to perform one function and some another. For example, some specialize in contraction (e.g., muscle cells), and some in secretion (e.g., sweat gland cells). The principle of division of labor prevails, as in a factory; but all cells, like all workmen, have the same fundamental nutritional needs, with special needs according to the work they do.



Some of the cavities of the body, without organs.

Kinds of Cells Composing the Body. In the body are found the following kinds of cells: (1) several kinds of *nerve* cells, composing the brain, the spinal cord, and other specialized structures of the nervous system; (2) three kinds of *muscle* cells (those in skeletal muscles, those in the walls of the hollow and the tubular organs, and those composing the heart); (3) several kinds of *epithelial* cells (in the skin and in the membranes that cover and line body cavities and organs; and a special kind known as glandular epithelial cells, composing whole organs and also widely distributed in the membranes); (4) several kinds of *connective*

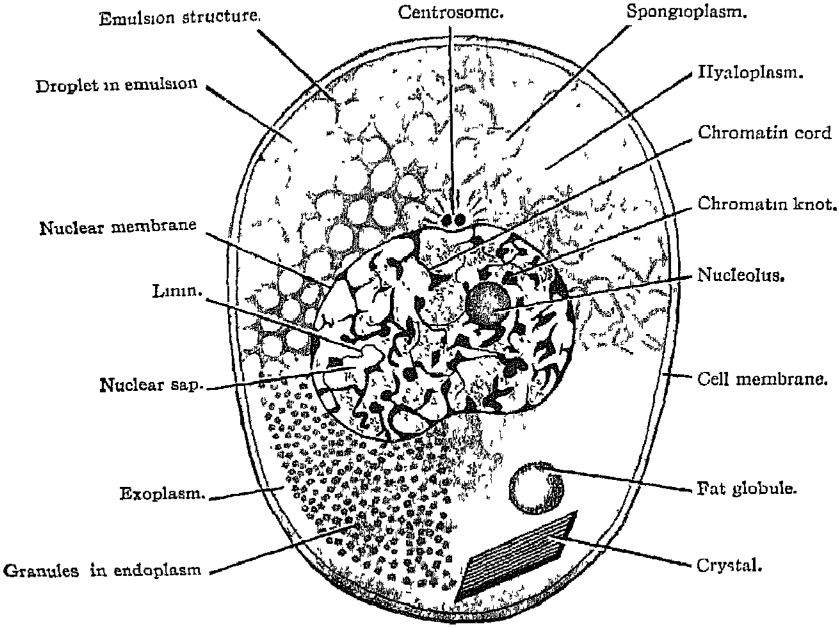


Diagram of a cell.

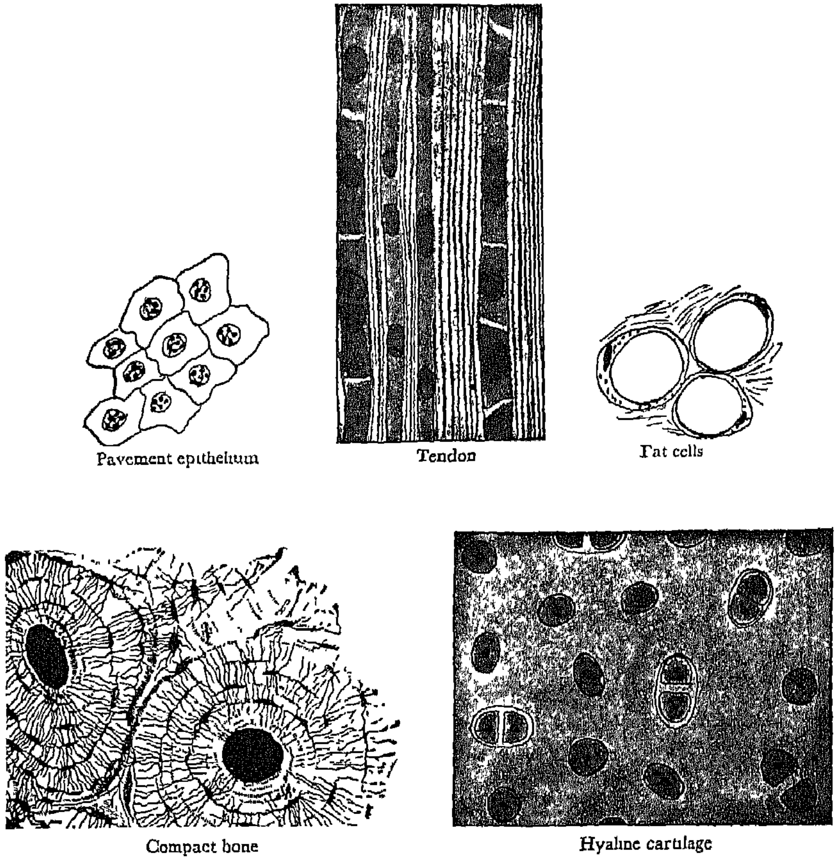
tissue cells, making up separate structures such as bones, tendons, and ligaments, and widely distributed among other tissues (e.g., fat connective tissue forming a layer under the skin and also mixed with other tissues, such as muscle); and (5) *special* cells (such as those of the blood and those resembling white blood cells but found throughout the body; and sex cells, found in the sex glands).

The Chemical Make-up of Cells. All cells are composed of protoplasm of which the main compound is protein, composed of carbon, hydrogen, oxygen, nitrogen, and a number of other elements.

The characteristic feature of the chemistry of protoplasm is its instability; it is a whirlpool of change. Materials are constantly entering cells, undergoing chemical change within them, and being discharged (excreted or secreted).

The sum total of all the chemical changes in a cell is called its metabolism. The processes that result in the upbuilding of the cells are called anabolism, and those that tend to break it down are called catabolism. The former are the result of nutritive processes, and the latter of expenditure of energy.

These two processes go on continuously, balancing each other during



Various types of cells.

the greater part of life (i.e., after full growth is reached and before senile changes begin), except as faulty nutrition, overfatigue, and disease may cause catabolism to exceed anabolism.

Although many chemical changes are the same in all cells (e.g., oxidation), the special metabolism of different kinds of cells differs according to the work they do.

Work of Body Cells. All cells produce energy and heat. They use some of their energy for maintaining themselves and some for performing their special work in the body.

Among the special work performed by cells may be mentioned the following:

MANUFACTURE OF INTERCELLULAR SUBSTANCE. All the connective tissues take substances from the blood which they elaborate and then

turn out to be deposited around themselves. After full growth is reached the need for more intercellular substance is not a daily occurrence, and the metabolism of connective tissues is therefore not very active. They must maintain their structure and be ready for occasions when repair is called for (e.g., to repair a broken bone).

CONDUCTION. The protoplasmic property of conductivity is especially well developed in nerve cells. They are known as the most highly specialized body cells because they perform one function better than any of the other cells and in their specialization have lost some of the other protoplasmic properties. For example, some of them are not able to repair themselves.

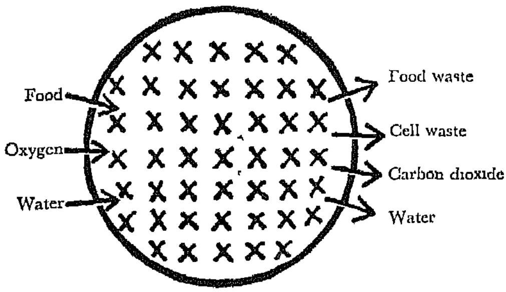


Diagram of cell in which chemical changes (X) are taking place, with substances which enter and leave all cells.

MANUFACTURE OF FLUIDS NECESSARY TO THE BODY. There are many different varieties of epithelial cells that are minute chemical factories, taking in chemicals, making them over into new substances, and giving off the product either upon a surface (e.g., saliva) or into the blood (e.g., thyroid gland secretion). These are known as gland cells and their products as secretions. Gland cells are grouped either in a membrane such as the skin or in solid organs such as the salivary glands or the thyroid gland.

MANUFACTURE OF FLUIDS TO BE EXCRETED FROM THE BODY. The process is exactly the same as that of secretion and is carried on by gland epithelial cells. The only difference is that in one case the product is of value, and in the other it is not.

MOTION. The muscle cells exhibit to a high degree the protoplasmic property of contractility whereby they become shorter and wider. As each cell contracts, so also does the whole muscle or the whole tissue containing muscle fibers.

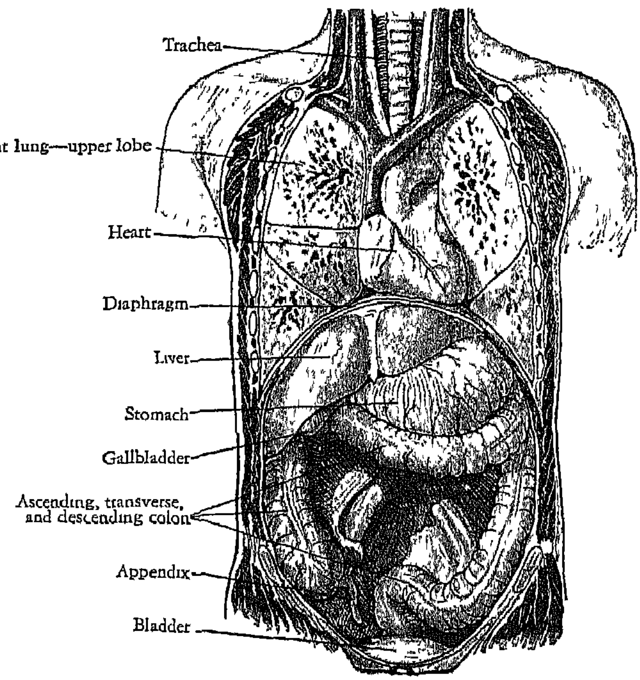
Various other sorts of specialized cellular work will be mentioned in other connections.

Organs of the Body. An organ is a structure so organized that it performs a special work (function) for the whole body economy. The skin, for example, is an organ for protection, sweat secretion, and several other purposes.

Usually an organ is composed of two or more tissues, each tissue performing its own function, and their combined functions serving the purpose of the organ. The skin, for example, consists of epithelial tissue, supporting connective tissue, fat tissue, etc.

Some of the organs are elaborate and complex structures doing work that could not be done by any other organ and are indispensable to life. The skin is in this category; so also are the brain, the heart, the liver, and various other organs.

The term system means a methodical arrangement. In the body, it means a set of organs working in conjunction with each other to perform a larger, more complex function than any single organ could perform. Also, it means a set of organs of similar anatomic structure.



Some of the thoracic and abdominal organs.

In most of the systems there are several organs. Furthermore, some organs take part in the work of several systems. Ten of the main systems will be mentioned briefly below.

The unified harmonious action of all parts of the body is a most remarkable phenomenon. That any one cell can act as it does is remarkable enough, but that millions of them should be able to act simultaneously in such a way that one need not even be aware of their functioning would be beyond comprehension if one knew nothing of the means of coördinating all this activity.

The various parts of the body are in constant relationship with each other in two ways: by means of chemicals and by means of nerve impulses.

CHEMICAL COÖRDINATION. There are many chemicals produced in the body that enter the blood, circulate in it, and, as they are delivered to cells, have the power to excite or to check their activity. They are called hormones. Chief among the hormones are the secretions of the endocrine glands.

Chemical regulation of body processes sometimes is called humoral (*humor,* fluid).

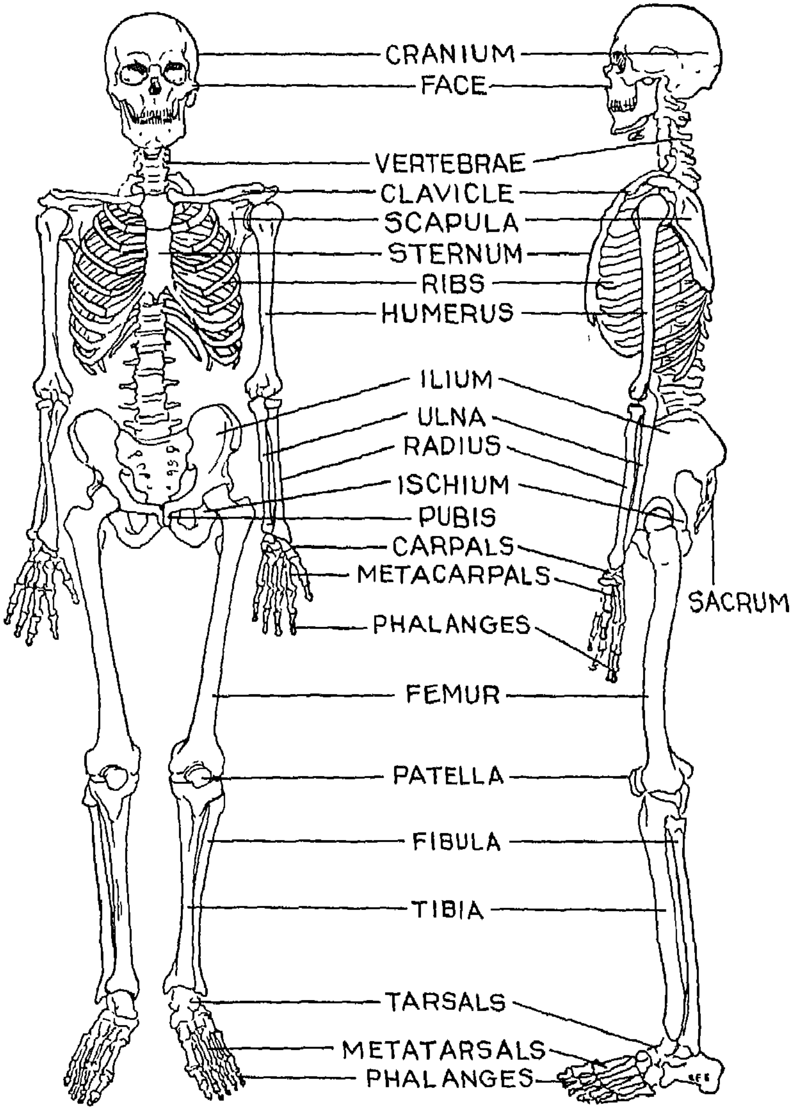
NERVE COÖRDINATION. All cells in the body respond to the nerve impulse, which is an electrochemical force that reaches them through the nerve fibers with which they are in contact. In medullated mammalian nerves, such as those supplying man with motor impulses, the nerve impulse travels at the rate of 100 meters per second.

The Body Functional Systems

There is a methodical arrangement for carrying on each and every function of the body. Some of those not mentioned here (e.g., temperature regulation) will be discussed in other chapters.

Skeletal System. The skeletal system consists of about 206 bones of various sizes and shapes. It supports the body as a scaffolding and forms part of the protective enclosures for most of the organs. These are its mechanical functions. It also has a physiologic function, that of producing red blood cells in the marrow within the bones.

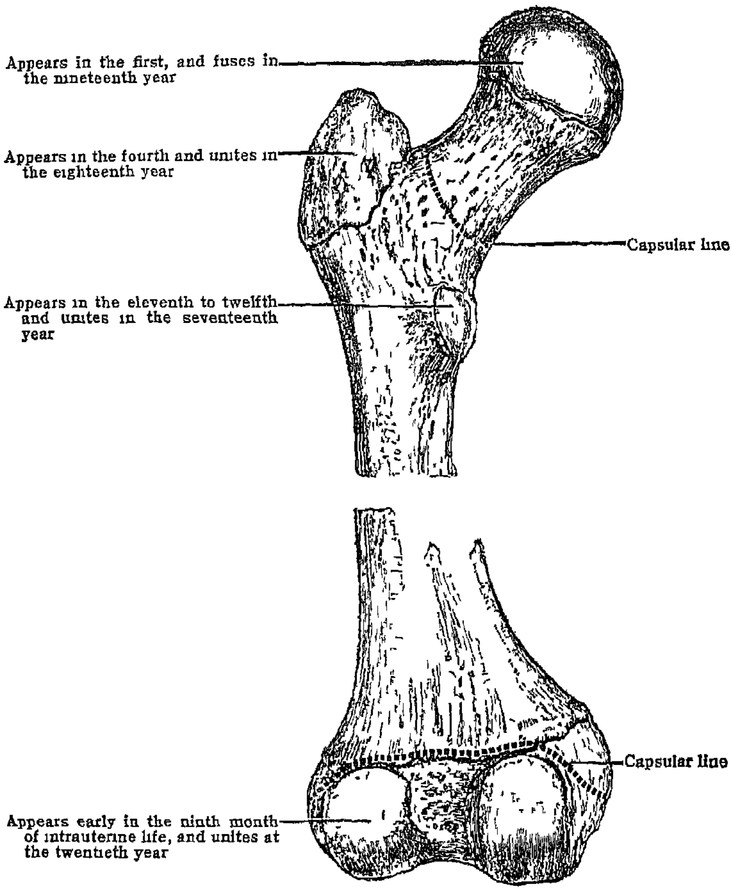
Bones come into relationship with each other at joints (i.e., articulate with each other). Motion is possible at many such articulations. When motion occurs at a joint it is because of contraction of skeletal muscles attached directly, or by tendons, to the bones on either side of the joint. The same contraction, when equalized, serves to prevent motion



The skeleton.

from taking place. Cartilage is interposed between the ends of the bones in joints to give resiliency in motion. In and around joints are firm bands of fibrous tissue called ligaments, which help to hold the ends of the bones in normal relationship to each other.

At birth, the bones are formed of cartilage. They are soft because of a lack of minerals in them. Gradually, during childhood and youth,



The left femur at the twentieth year (Posterior view) The figure shows the relations of the epiphyseal and capsular lines

minerals, if the diet provides them, are deposited in the bones, which become hard by process of ossification (bone formation).

Muscular System. All muscle tissue has the power to contract (become orter and wider) and relax. Also, it can be stretched and, if normal, ll recoil afterward like elastic. Muscle tissue normally is slightly conicted or not completely relaxed; this property is known as tone.

In the body, contraction of muscle takes place largely in response to uli received from motor nerves. Its contractile power depends upon nical processes that go on in it. The chief is oxidation or the com- ig of oxygen with fuel (with the release of heat and energy) and of

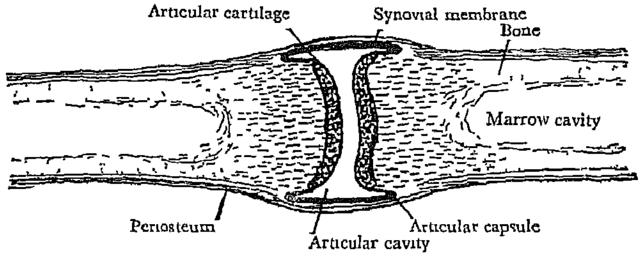


Diagram of a hinge joint such as the knee.

carbon dioxide and water. The muscles constantly contain the fuel glycogen, formed largely from carbohydrate food.

SKELETAL MUSCLES. There are over 500 muscles arranged about the skeleton to produce motion of its parts and locomotion of the whole. Each muscle consists of small bundles of muscle cells encased in fibrous tissue, the whole surrounded by a fibrous sheath. At one end the muscle usually is attached directly to a bone, and at the other end to another bone by a tendon which consists of a prolongation of the fibrous tissue of the muscle.

Muscle contraction causes motion at joints, since the shortening of the muscle brings its two ends nearer together and decreases the angle between the bones to which it is attached. Many of the skeletal muscles are arranged in antagonistic sets on opposite sides of a joint, one set causing flexion and the other extension; when one set contracts and the other relaxes, motion takes place, and when both sets contract equally (or neither contracts), no motion occurs.

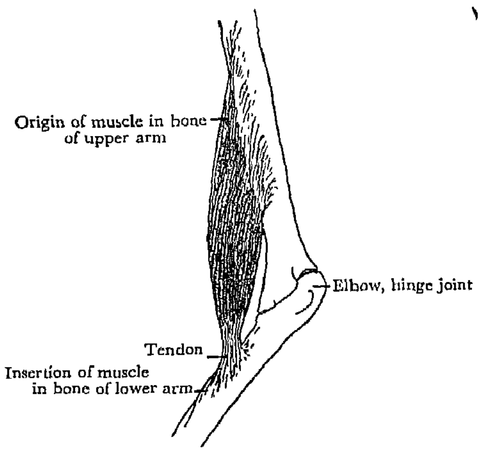
The function of some of the skeletal muscles is that of enclosing cavities and protecting organs (e.g., abdominal muscles, which require constant contraction in order to serve their purpose of holding organs in place).

All skeletal muscles are voluntary (i.e., under the control of the will), but they may be used in an almost involuntary fashion as a result of habit (e.g., walking) or reflexly in an entirely involuntary way (e.g., swallowing, winking). Conversely, as a result of lack of attention and practice, certain muscles, although voluntary, may not be controlled (e.g., abdominal muscles, muscles controlling motion of the ears, etc.).

VISCERAL MUSCLE. This term is applied to the muscle tissue such as that in the walls of hollow organs and tubular structures (viscera, organs). Such muscle when it contracts changes the shape of the organ in which it is found, usually with the result that the contents of the

organ are compressed and extruded from the organ or moved onward within it. This is the function of the muscle tissue in, for example, the food tube, the bladder, the uterus, etc. At some of the openings of the body, visceral muscle forms rings, or sphincters, whose contraction retains the contents and whose relaxation permits the contents to be extruded (e.g., sphincters at the outlet from the large intestine and from the bladder).

Visceral muscle is found also in the walls of the arteries, in which location its elasticity is its most important property. Such muscle fibers



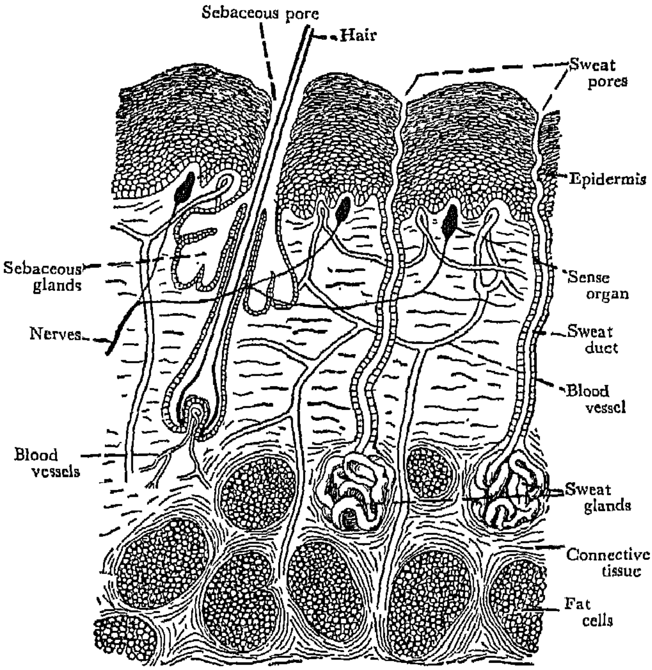
Origin and insertion of one of the flexor muscles of the arm.

are stretched passively at each beat of the heart and recoil immediately afterward.

Because of its microscopic structure, visceral muscle is called smooth muscle, and because ordinarily it is not under the control of the will it is called involuntary muscle.

HEART MUSCLE. A special type of muscle composes the greater part of the heart. It contracts involuntarily and regularly (normally 70 to 80 times per minute) to press the blood from one of its chambers to the next and finally outward into blood vessels.

Tegumentary System. The outermost layer of the body is the skin, which is continuous at the body apertures with a pinkish tissue called mucous membrane. The latter extends within the body. A continuous sheet of it lines the whole of the respiratory and digestive tracts; another sheet of it lines the whole of the genital and urinary tracts. A similar



A section through the skin to show its structure. Note the sweat glands with long tubes, the hair roots, and the position of the sense organs just beneath the epidermis. (Modified from Folsom.)

membrane lines all closed cavities (e.g., the peritoneal cavity or cavity of the abdomen, the joints, the skull cavity, etc.) and also encases the organs.

All membranes, including the skin, are for mechanical protection of the parts they cover. Also, all secrete fluid. In the interior of the body this fluid acts as a lubricant between moving parts (e.g., in joints, between the lungs and the chest wall). Some of the membranes have additional functions (e.g., the mucous membranes of the intestinal tract produce not only mucus but also certain of the digestive juices). The skin, in particular, has several additional functions.

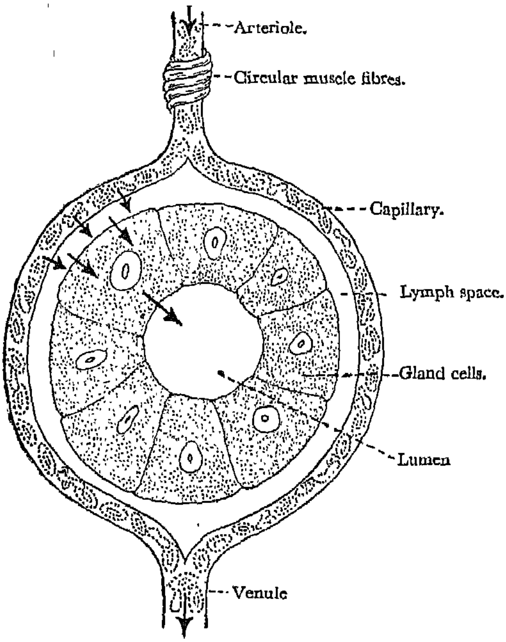
The skin consists of many layers, the outermost cells being thin, flat, and dead. Skin cells reproduce rapidly; the lowermost layers grow, and the outer dead cells are constantly being shed.

Deep in the skin are secretory glands of two sorts, producing two secretions, sweat and sebum, which are carried to the surface by ducts ("pores"). Sebum is an oily substance to keep the skin pliable and, to

some extent, waterproof. Sweat is largely water, and its main purpose is that of evaporating on the surface, thereby cooling it and lowering the body's temperature.

The skin is an important storage place; it stores fat and sugar as "emergency rations," water, and vitamin D.

Endocrine System. In various places throughout the body are glandular organs which take materials from the blood, change them over, and return to the blood the new products they have manufactured.



Secreting gland.

When this "manufacturing" process was first discovered, the hitherto mysterious glands were named endocrine, which means "to separate within."

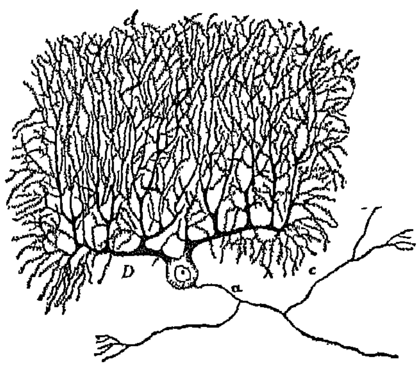
Because the endocrine secretions enter the blood and remain in the body, they are called internal secretions to distinguish them from external secretions that are discharged through ducts to internal or external body surfaces (e.g., the digestive juices, sweat, etc.). Some of the glandular organs produce both sorts. For example, the pancreas produces digestive juices that enter the small intestine and also insulin, which enters the blood.

Each of the endocrine glands produces a distinctive secretion of its

own. All are hormones or chemical messengers. As they circulate through the body they act upon the various tissues and organs either to stimulate their action or to inhibit them in various specific ways. For example, the thyroid hormone stimulates general metabolism of the body.

Together, the endocrine glands form a system affecting all the functions of the body. The various glands work in harmony with each other, and the whole system and each gland in it work in harmony with the nervous system in coördinating all life processes.

The glandular organs whose exclusive function is the production of internal secretions are: the *pituitary* at the base of the brain; the *thyroid* and the *parathyroids,* in the neck; and the *adrenals* or suprarenals, in the region of the kidneys. Among those that produce internal secretions and also have other functions are: the *pancreas,* in the region of the stomach; and the *gonads* or sex glands (testes, or testicles, and ovaries) in the pelvic region.



Purkinje cell from the cortex of the brain.

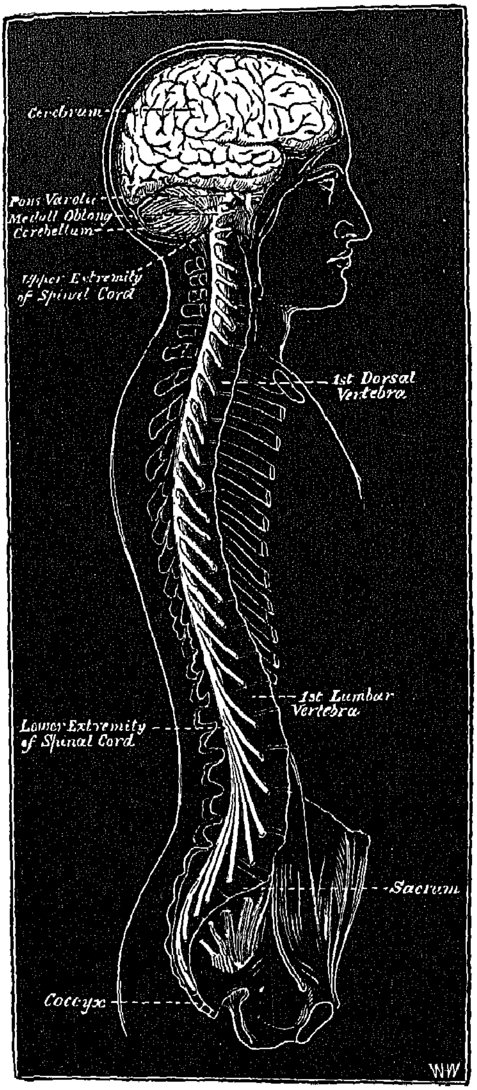
The function of the individual glands is more fully discussed in connection with their disorders, in Chapter 13.

Nervous System. The nervous system includes the brain and spinal cord, where lie the cell bodies of the nerve cells (neurones). From each cell extend many small fibers and one long one. Long fibers extend outward toward the various parts of the body; those following the same direction form bundles called nerves.

Nerves carry the nerve impulse, which is an electrochemical force. When any nerve is stimulated at its ending, electrochemical changes take place at the spot and are propagated along the entire nerve in much the same fashion as the burning fuse which finally ignites gun powder.

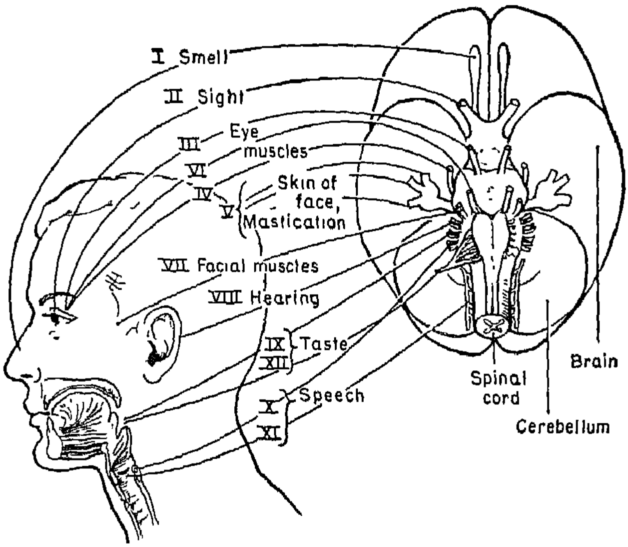
Nerve impulses travel in two directions in the body: (1) from all parts of the body toward the cell bodies in the "central stations" in brain and spinal cord; and (2) away from the centers toward all parts of the body. The ingoing impulses are called afferent and the outgoing efferent.

Afferent nerves are sensory—that is, they carry sensation. The



The cerebro-spinal axis of the nervous system, showing the spinal nerves cut at the points where they pass out from the dorsal cavity.

senses are: vision, hearing, taste, smell, touch (the "five senses"), and also pain, temperature (warm and cool), equilibrium, kinesthesia (the sense of position and motion, due largely to muscle, joint, and tendon sensitivity), and various organic sensations which we know in blends such as hunger and thirst. In general, the sensory nerves have



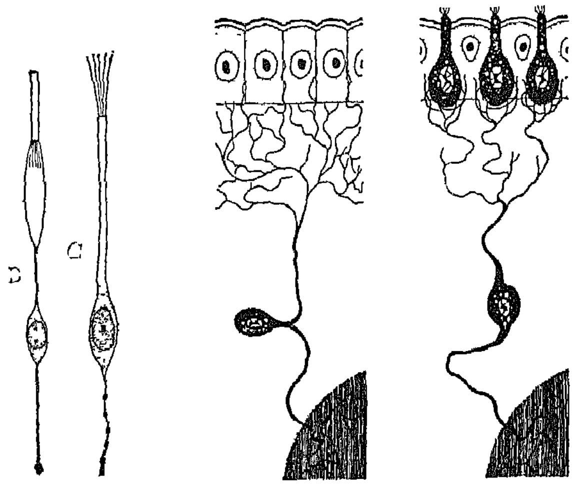
Ventral view of the brain (*right*) to show the origin of the 12 cranial nerves, and (*left*) the regions of the face and neck they innervate.

special end-organs or receptors adapted to receive only one kind of sensation and not others. For example, certain cells in the eyes are the receptors of the optic (eye) nerves. These and some of the other senses carry "information" from the outside world; whereas kinesthetic and organic sensations carry information regarding the body itself. Some of these sensations are not regularly felt as such.

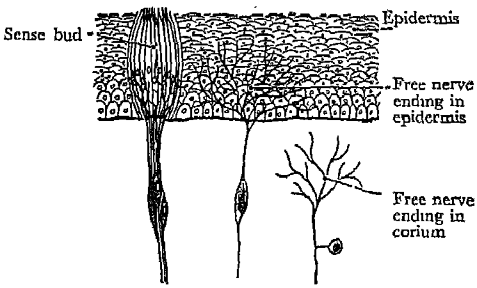
Efferent nerves carry action messages to muscles (motor nerves) and glands (secretory nerves).

When an afferent nerve is excited by a stimulus, the nerve impulse travels to its cell bodies in one of the centers and thence to other cell bodies which in turn excite a response by an efferent nerve.

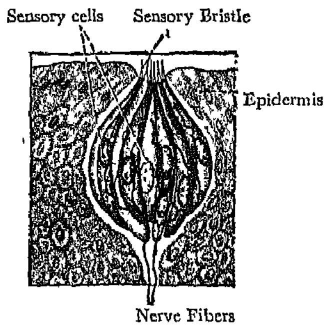
The route of the nerve impulse usually is through two or more association, or connector, neurones between the incoming and outgoing. In some cases the route is through a large number of association neurones. This is especially the case with impulses that travel to the cortex (outer layer) of the cerebral hemispheres. Responses that come quickly after a short and direct route into centers and out again are called reflex or automatic. Those that come after traveling an intricate route through the cortical association neurones where the brain activity known as thinking takes place are called voluntary. Voluntary responses may, however, become reflex as a result of habit formation.



Sensory cells. (*Left*) (A) Cell from the sense organ (crista acoustica) of an ampulla of the ear. (B) Rod cell from the retina. (C) Cell from the olfactory epithelium. (After Furbringer.) (*Center*) Primary sensory cell with free nerve termination. (*Right*) Secondary sensory cells convey impulses to the primary sensory cell. (After Kahn.)



Sensory nerve endings in the skin.



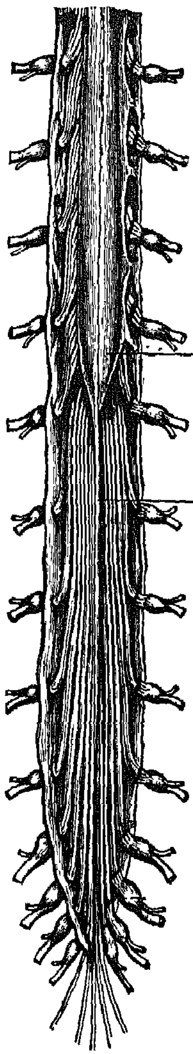
Taste buds in the tongue.

It should be noted that responses have the effect either of producing action or of checking or inhibiting it. They are of equal importance in the body economy and in life as a whole.

All vital body functions are regulated by reflex or automatic nerve action (in conjunction with hormones mentioned in the previous section). Upon "information received," headquarters issues orders. The orders may be to act or not to act; balance of body functions is maintained by activating one function and checking the action of another, as circumstances may require.

Moment by moment all the vital functions are carried on according

to this principle, and the normal person knows nothing of their workings unless something happens to disturb the quiet harmony. For example, the amount of perspiration secreted by the skin is kept in proportion to the body's need for cooling, and the rate of breathing is kept suitable for the body's need of oxygen. When disorder exists, however, sensory impulses travel to the cortex to call attention to the need for voluntary action to correct the situation. For example, although digestion normally proceeds quietly, a "stomach-ache" is felt when the automatic processes are having difficulty. A special system of nerves, the autonomic system, provides for the automatic responses of the organs.



Cauda equina.

In and near the spinal cord and the brain there are centers which serve as receiving stations for sensations and as dispatching centers for motor and secretory impulses. Also, there are special centers for the control of the vital processes of heart action, breathing, and temperature regulation. Finally, there are the elaborate association areas in the cortex (outer layer) of the brain, which have already been mentioned as the areas where cerebration (thinking) occurs and where voluntary action originates.

The nervous system is a coördinating mechanism. It brings every part of the body and mind into relationship with every other part, thereby serving as a means of internal adaptation. It also brings the individual in touch with the environment, thereby serving as a means of adaptation to the external conditions of living. All parts of it and all of its responses are essential; but the cortex of the brain, which makes possible planned adaptive responses, is at times the *sine qua non* in adaptation.

Cerebral functions are discussed in Chapters 5 and 15 to 18.

Circulatory System. This system consists of the heart, a hollow muscular organ which acts as a pump to send blood out from it into the

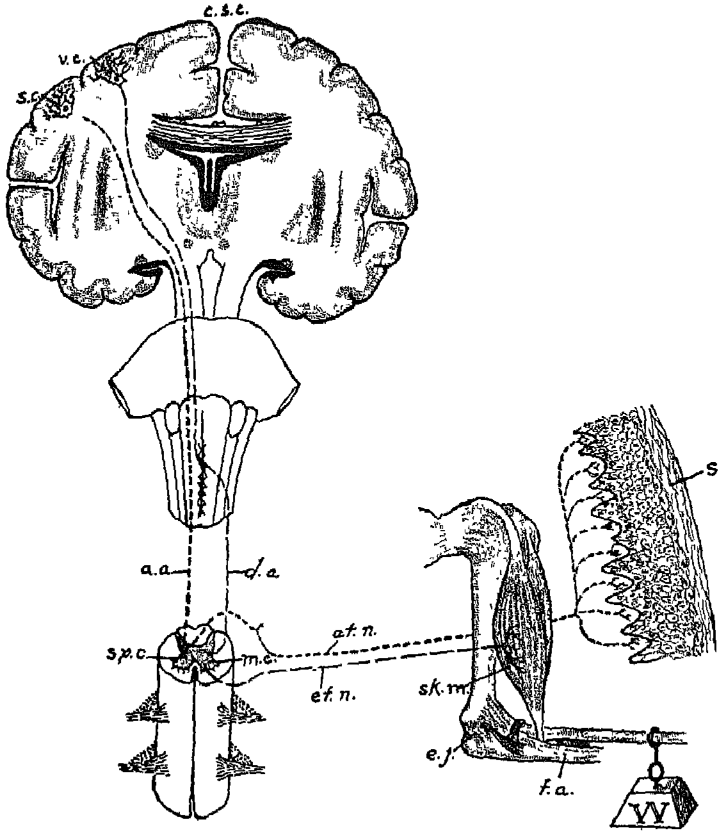
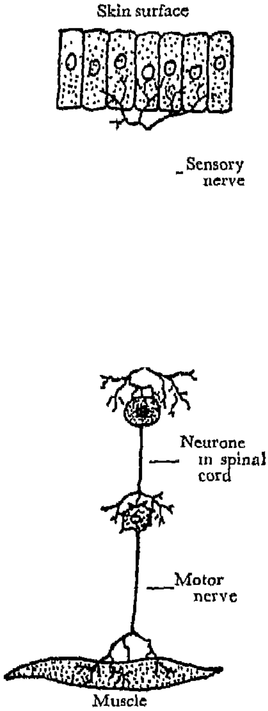


Diagram showing the relation of skeletal, muscle, and nerve tissues. (*f.a.*) Bones of the forearm representing the skeletal tissue. (*e.j.*) The elbow joint, the fulcrum of the lever formed by the bones of the forearm. (*W*) A weight acting in a downward direction and representing the passive force of gravity. (*sk.m.*) A skeletal muscle acting in an upward direction and the source of the active power to be applied to the lever. (*sp.c.*) Transection of the spinal cord showing the relation of the white and the gray matter. (*m.c.*) A motor cell in the anterior horn of the gray matter. (*ef.n.*) An efferent nerve fiber connecting the motor cell from which it arises with the skeletal muscle and contained in the ventral roots of the spinal nerves. (*af.n.*) An afferent nerve fiber arising from the ganglion cell along its course and connecting the skin, (*s.*) on the one hand with the spinal cord on the other hand and contained in the dorsal roots of the nerves. (*c.s.c.*) Coronal section of the cerebrum showing the relation of the gray to the white matter. (*v.c.*) A volitional or motor cell. (*d.a.*) A descending axon or nerve fiber connecting the volitional cell from which it arises with the motor cell in the spinal cord. (*s.c.*) A sensory cell. (*a.a.*) An ascending axon or nerve fiber connecting a receptive cell from which it arises (not shown in the diagram) with the sensory cell in the gray matter of the cerebrum. The nerve fibers which pass outward from the spinal cord to the glands, blood vessels, and the muscle walls of the viscera, have for the sake of simplicity, been omitted from the diagram. (*G. Bachman.*)

blood vessels, a system of tubes carrying blood away from the heart to all parts of the body (arteries) and from all parts of the body back to the heart (veins). Blood constantly circulates through this system and also through a special circuit from the heart to the lungs and back.

Arteries branch and rebranch until finally they are minute vessels called capillaries. Materials needed by cells pass outward from capillaries into cells; waste products of cells and products to be used elsewhere pass outward from cells into capillaries.

The fluid normally present between cells is the middleman between cells and the blood. Some of this intercellular fluid does not, however, enter capillaries but passes into lymph vessels which originate in the spaces between cells and finally empty into the large veins and thence into the heart. Along these vessels are lymph nodes containing phagocytic cells having functions similar to those of some of the white blood cells.



Reflex arc.

Blood consists of a fluid, plasma, in which float red cells (carriers of oxygen), white cells (including phagocytic cells which "devour" bacteria and other foreign material), and platelets, concerned in the clotting of blood.

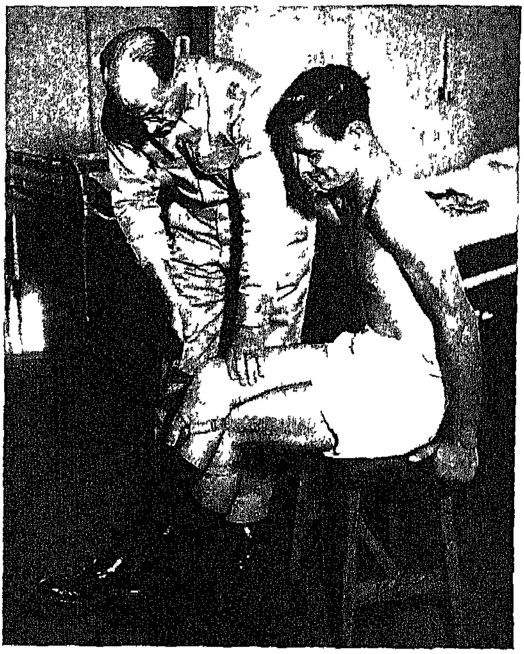
Further discussion of the circulatory system will be found in Chapter 3.

Respiratory System. Air is breathed into and out from the lungs through the air passages (nose, throat, larynx, trachea, and bronchi). The nose contains a middle partition, the septum, and on each side wall three curved structures called the turbinate bones. All are covered with mucous membrane constantly secreting a small amount of fluid mucus. From the nose narrow passages lead into the sinuses (hollow spaces in the bones of face and skull). Air entering through the air passages is warmed and moistened in preparation for its entrance into the lungs.

The lungs are two large organs whose structure somewhat resembles bunches of grapes, with hollow stems (bronchioles) and grapes (alveoli). Capillaries closely surround each alveolus, and oxygen from

the air in the alveolus passes through its wall and the capillary wall into the blood where it unites with an iron-containing substance (hemoglobin) in the red cells. While oxygen is being taken into the blood, carbon dioxide is being given off.

The final step is tissue respiration which takes place when oxygen is released from the red cells and taken up by each of the body cells,



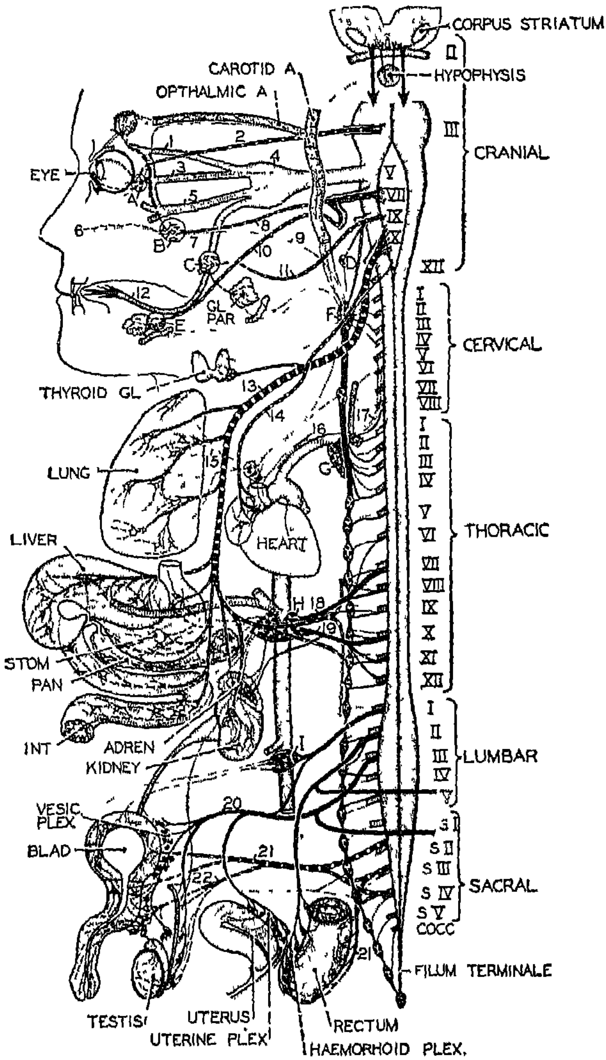
This man is having his patellar reflex or "knee jerk" tested. (Courtesy, *Today's Health*, formerly *Hygeia*)

at which time they also give off carbon dioxide. Oxygenation of the tissues is discussed in Chapter 3.

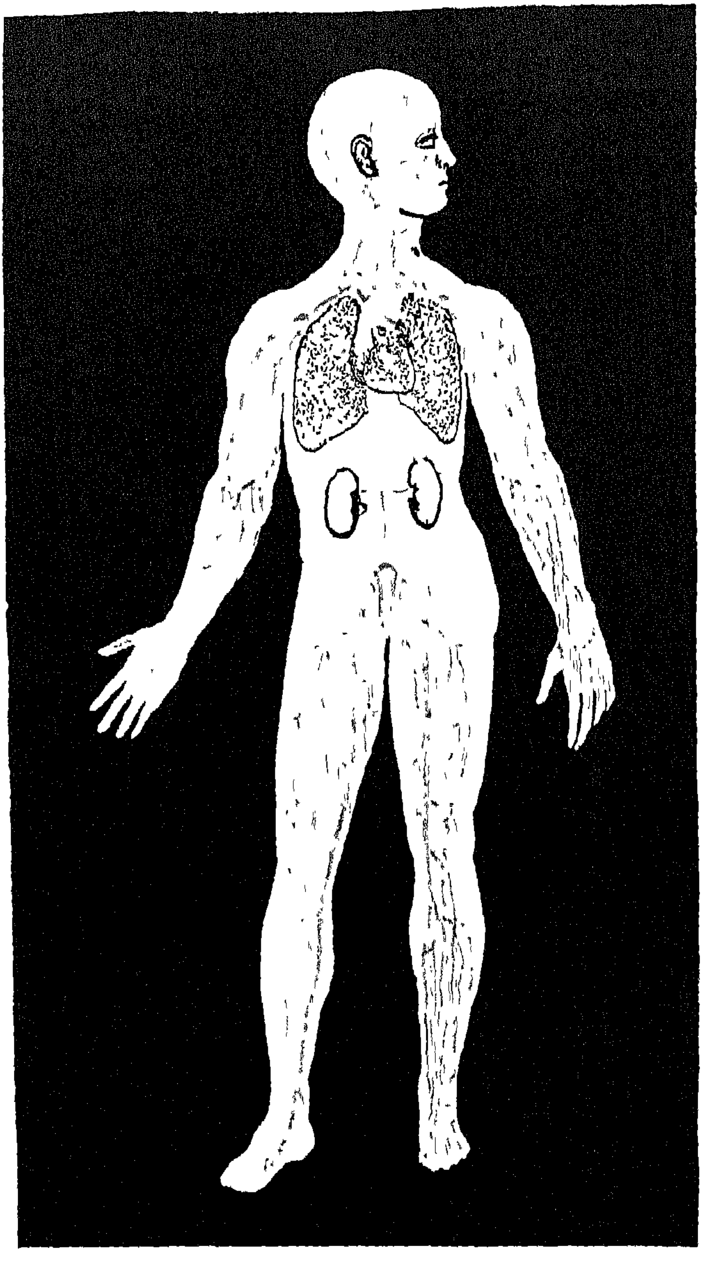
Expansion of the lungs is due to automatic contraction of muscles between each two ribs and a sheet of muscle (diaphragm) stretching across the trunk at the base of the lungs. These muscles may be used voluntarily for a limited time only. Rate and depth of breathing are governed automatically, largely by the percentage of the waste gas, carbon dioxide, in the blood requiring removal.

The larynx is a boxlike structure between the throat (pharynx) and the trachea, so situated that the air current from the lungs passes across its "strings," the vocal cords, causing them to vibrate in sound.

Digestive System. The single-celled organism takes up nutriment directly from its environment. Body cells do the same; the nutritive materials reach the fluid in spaces between them and are absorbed from there. Before this can happen, however, food travels over a long route from the mouth and undergoes many changes.



The autonomic nervous system in man. At the right are a brain structure (corpus striatum), the pituitary gland (hypophysis), the nuclei of certain cranial nerves, and the spinal cord, with the chain of spinal ganglia At the left are some of the organs which act involuntarily as a result of autonomic impulses.



Scheme of systemic circulation. Arteries colored red, veins, blue.

Leaving the mouth, food passes downward through the food tube (alimentary or gastrointestinal tract). It passes first through the gullet or esophagus; then into the stomach, a saclike enlargement of the tube; then into the small intestine, a tube 20 feet long or more; then into the large intestine (large bowel or colon), a tube of larger caliber and several feet long, terminating in the rectum. Food residue finally leaves the body by the anus.

Muscle fibers throughout the stomach and intestines are responsible for motion (peristalsis). Motor activity in the stomach consists of a churning motion and a propulsive motion, which send food through the pylorus (gate) into the duodenum or first part of the small intestine. Throughout the small and large intestines, the motion is back and forth, with lengthwise and circular constrictions, but in general in an onward direction.

The stomach and small intestine produce secretions, called enzymes or digestive juices, which become mixed with the food and exert a chemical action upon it, digesting it. All food except sugar requires digestion into simpler substances before it can be absorbed.

Digestion begins in the mouth where food is ground into particles by the teeth and mixed with the saliva, a digestive enzyme.

Near the stomach are the liver and pancreas. Both of these organs have other functions, but both belong to the digestive system. The liver forms bile, which has an important role in digestion of fats, and the pancreas forms

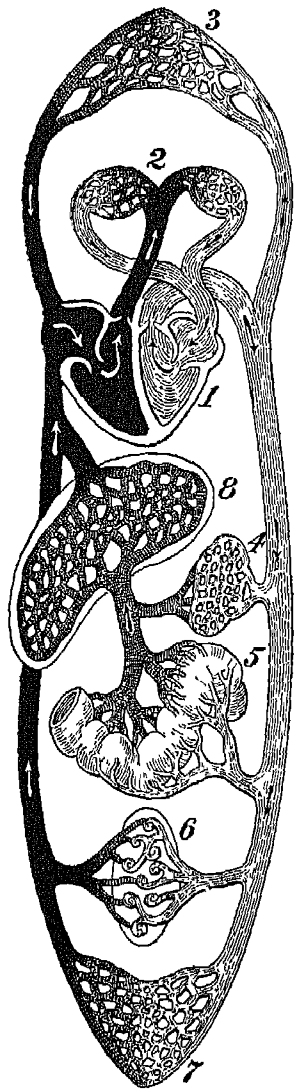
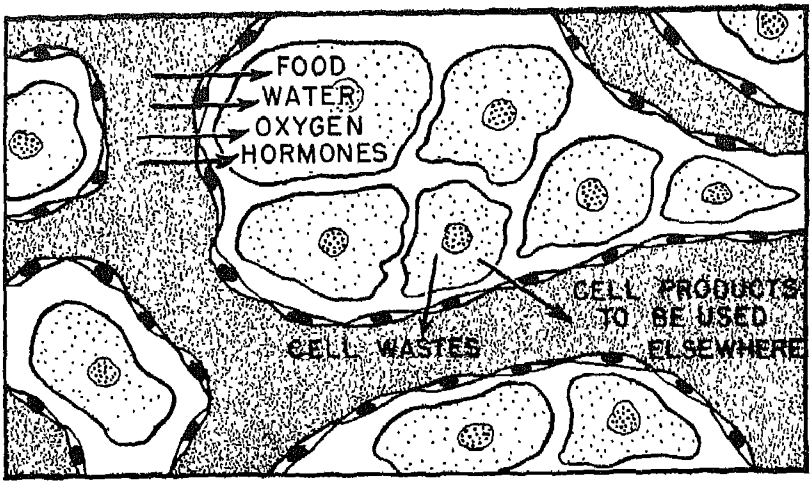


Diagram of the circulation. (1) Heart. (2) Lungs. (3) Head and upper extremities. (4) Spleen. (5) Intestines (6) Kidney. (7) Lower extremities. (8) Liver. (After Dalton.)



Capillary blood vessels (shaded) flowing among cells. (Space between cells is exaggerated to show presence of intercellular fluid.) Note exchange between blood and cells.

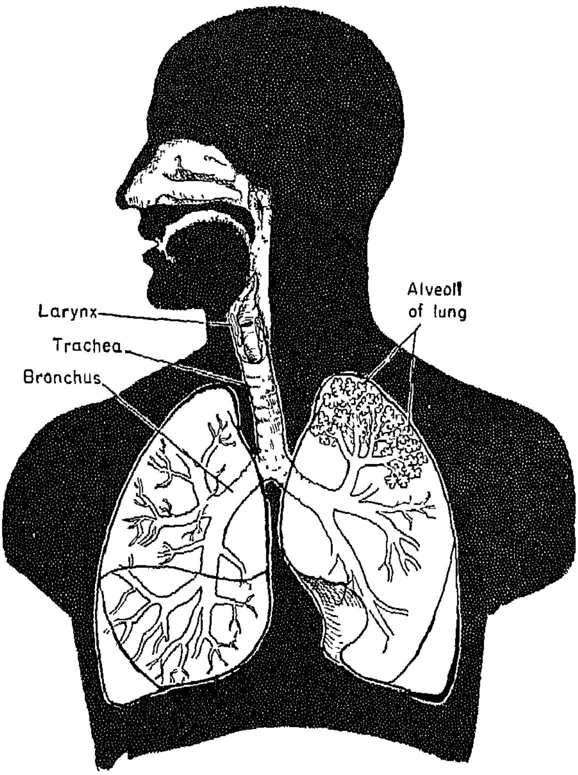
several digestive juices. Bile goes from the liver to the gallbladder for storage until needed. During digestion it enters the duodenum through a duct which also carries the pancreatic juice.

The semifluid substances formed from foods by digestion are absorbed directly through the wall of the small intestine into the blood. In the colon much of the remaining water is absorbed, and the residue (feces) is semisolid.

After absorption, nutriment travels in the blood stream to the vicinity of each cell which takes what it needs and assimilates it (turns it into its own substance) provided *intake, digestion, and absorption* have been adequate.

Excretory System. This system consists of the two kidneys and the bladder, with the tubes from the kidneys to the bladder (ureters) and the tube from the bladder to the exterior (urethra). It is the only system with the exclusive function of ridding the body of nitrogenous waste.

All cells of the body give off their waste into the blood. Some of this waste would be poisonous if retained. This is particularly true of nitrogenous waste from the breakdown of protoplasm of cells and from nitrogenous (protein) food. As the blood circulates through the body, nitrogenous waste is taken up by the liver which makes it into a substance called urea. The liver then turns urea into the blood, and as the



The respiratory tract. Note that inspired air finally penetrates to thin-walled lung alveoli.

blood passes through the kidneys, they take urea and many other substances, including water, from the blood and make a fluid product (an excretion) called urine. Urine is constantly being formed and constantly flows from the kidneys into the bladder.

The bladder is an elastic, muscular sac capable of distending so as to hold a pint or more of accumulated urine. The urethra is guarded by a sphincter muscle which, after infancy, reflexly remains closed except when voluntarily relaxed for voiding the bladder in the act of urination or micturition, which usually occurs four or five times during the waking hours and not at night.

Reproductive System. This system is discussed in Chapter 19.

Disease and Recovery

What Is Disease? Disease is change from the normal in the structure of body tissues or in their functioning or both. When the structure of

the body is impaired the changes are demonstrable to the sight and other senses of the physician. In the early stages these changes may be evident only upon microscopic examination of tissues; or by characteristic changes they produce in body fluids such as the blood or the urine; or in the way in which the body functions, as, for example, by abnormalities of the nerve reflexes. A disease is called organic when it is based upon structural changes, however demonstrated.

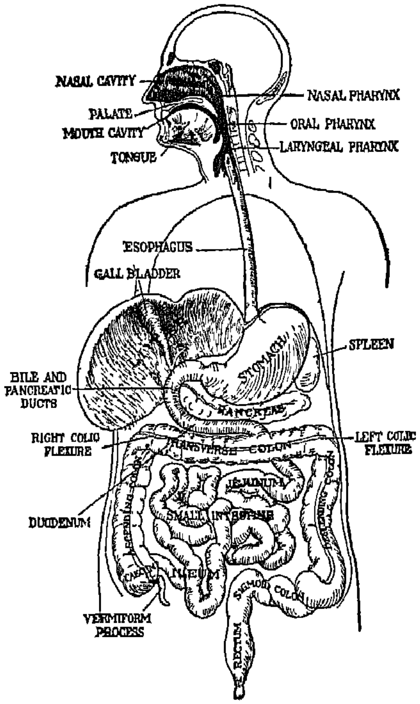
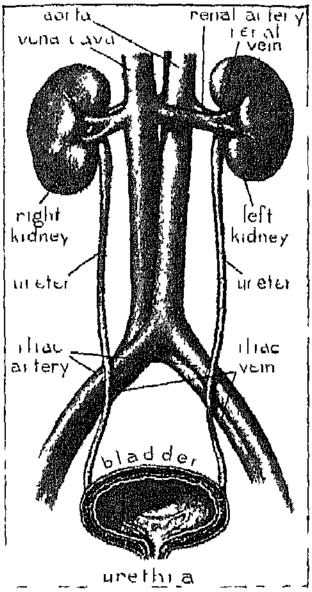


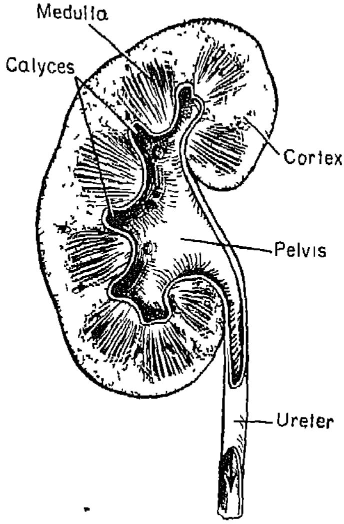
Diagram of the alimentary canal.

Among the prominent causes of the structural changes comprising disease are injuring agents from the exterior (microbial, physical, and chemical). Causes originating chiefly within the interior of the body, such as tissue degeneration and the like, depend upon hereditary make-up, with or without demonstrable effects of external causes as well.

When body functions are impaired and no structural change can be demonstrated the disease is called functional. Many conditions may temporarily upset one function or another without damaging any tissue of the body. An example is fainting due to marked changes in the distribution of the blood.



The kidneys and bladder, posterior view.



Cross section of kidney.

It should be noted that if its functions are disturbed an organ may undergo structural changes as a result. These may occur only after a long period of time (e.g., blindness may eventually occur in a crossed eye not used for seeing).

Although there are many causes of disturbed function, as will be noted in the following chapters, one of the most frequent causes is emotional. This important type of illness is discussed in Chapter 14.

Diseases are classed according to their duration as acute (brief) and chronic (long lasting). Some of the acute conditions are responsible for many deaths (e.g., pneumonia, accidents), but the chronic conditions cause the largest percentage of all illness and the majority of all deaths.

Disease is classed also as hereditary or acquired. Hereditary disease is due to determining factors in the germ cells from which the individual is formed, as explained in Chapter 20. A large proportion of illnesses are acquired during the lifetime of the individual. If acquired before birth, a disease is called congenital; frequently such conditions are inconsistent with life up to the time of birth, causing stillbirth, or are responsible for death in infancy.

Recovery. The general tendency of the body is toward self-healing,

and some of the tissues recover automatically after some types of disease if the damage has not been too great.

When recovery occurs, it may be (1) regrowth of the same sort of tissue that has been damaged; or (2) replacement of the damaged tissue by another sort—fibrous tissue. In the former case, normal function is restored; but in the latter case, the fibrous tissue heals the area but does not perform the same function as the tissue destroyed (e.g., fibrous scar tissue replacing the transparent tissue over the front of the eyeball does not transmit light, hence does not restore the function of vision).

A process of compensation occurs in many diseases, whereby the function of a damaged organ is taken over by another organ. This is notable especially in paired organs such as the kidneys. Compensation sometimes takes the form of an increase in the size of an organ. For example, the heart may enlarge when otherwise its strength would be inadequate for its work.

The curative processes of the body also include a vast number of chemical changes of an adaptive nature. Many of these involve increased production or increased excretion of chemicals according to need.

Of the utmost importance is the body's production of specific chemicals in response to invasion by bacteria, these chemicals having a tendency to destroy or neutralize the bacteria or their toxins. This matter will be discussed in Chapter 9.

Against some injuring agents the body has little or no tendency to self-healing. This is the case with cancer and most types of tissue degeneration. In such conditions, if the disease is to be checked or cured, it can only be by medical or surgical treatment. Even with conditions from which self-cure might be expected, treatment by physicians often may turn the balance in favor of success in this process.

Table 5

MORTALITY RATE PER 100,000 IN THE UNITED STATES, 1947*

1. **Communicable diseases**		55.9
Tuberculosis (all forms)	33.5	
Syphilis	8.8	
Whooping cough	1.4	
Influenza	5.3	
Others	6.9	

* Vital Statistics of the United States.

Table 5—(Continued)

2. Cancer and other tumors		136.4
Cancer of the digestive organs and peritoneum	58.0	
Cancer of the breast	12.6	
Cancer of the uterus	12.2	
Cancer of the respiratory system	12.1	
Others	41.5	
3. Rheumatism, diseases of nutrition and endocrine glands, etc.		32.3
Diabetes mellitus	26.2	
Diseases of the thyroid and parathyroid glands	1.9	
Chronic rheumatism and other rheumatic diseases	1.3	
Others	2.9	
4. Diseases of the blood and blood-forming organs		7.9
Leukemias and aleukemias	5.1	
Anemias (except splenic anemia)	1.9	
Others	.9	
5. Diseases of the nervous system and sense organs		101.8
Intracranial lesions of vascular origin	91.4	
Diseases of the spinal cord	1.8	
Epilepsy	1.6	
Meningitis (not due to meningococcus)	1.4	
Mental diseases and deficiency	1.1	
Others	4.5	
6. Diseases of the circulatory system		344.5
Diseases of heart (all forms)	321.2	
Arteriosclerosis (except coronary or renal)	17.7	
Aneurysm (except of heart and aorta)	1.6	
Others	4.0	
7. Diseases of the respiratory system		48.0
Bronchopneumonia (including capillary bronchitis)	19.6	
Lobar pneumonia	14.1	
Pneumonia (unspecified)	4.1	
Hemorrhagic infarction, thrombosis, edema and chronic congestion of the lungs	2.9	
Bronchitis	2.4	
Others	4.9	
8. Diseases of the digestive system		43.3
Cirrhosis of the liver	10.4	
Hernia and intestinal obstruction	7.5	
Ulcer of stomach or duodenum	6.0	
Diarrhea, enteritis, and ulceration of intestines (under 2 years of age)	4.2	
Appendicitis	3.3	
Others	11.9	

Table 5—(Continued)

9.	**Diseases of the genito-urinary system**		65.5
	Chronic nephritis	51.8	
	Diseases of the prostate	4.9	
	Nephritis unspecified (ten years of age and over)	2.7	
	Others	6.1	
10.	**Congenital malformations**		14.2
	Congenital malformations of central nervous system	4.2	
	Congenital malformations of the cardiovascular system	10.0	
11.	**Diseases peculiar to the first year of life**		45.5
	Premature birth	28.6	
	Injury at birth	9.1	
	Congenital debility	1.2	
	Others	6.6	
12.	**Violent or accidental deaths**		87.0
	Accidental deaths	69.4	
	Suicide	11.5	
	Homicide	6.0	
	Others	0.1	
13.	**Senility**		6.8
14.	**Diseases of pregnancy, childbirth, and the puerperium**		3.5
	Abortion	0.3	
	Toxemia	0.3	
	Hemorrhage	0.5	
	Infection	0.7	
	Others	1.7	
15.	**Diseases of the bones and organs of movement**		0.5
	Osteomyelitis and periostitis	0.1	
	Diseases of the joints and other organs of movement	0.2	
	Others	0.2	
16.	**Diseases of the skin and cellular tissue**		0.7
	Phlegmon and acute abscess	0.1	
	Others	0.6	
17.	**Chronic poisoning and intoxication**		1.6
	Acute alcoholism	0.6	
	Chronic alcoholism	0.6	
	Other	0.4	
18.	**Ill-defined and unknown causes**		12.4
	Sudden death	0.8	
	Ill-defined and unknown causes	11.6	

Part 2

Daily Maintenance of Health

3

Keeping the Circulation Good

One of the prime essentials for health is that the blood should constantly circulate throughout the body in suitable amounts and at a suitable rate. It is also essential, of course, that the blood be of suitable quality.

Circulation

In the adult, the body normally contains 6 to 7 quarts of blood carried in the heart and the 62,000 miles of blood vessels.

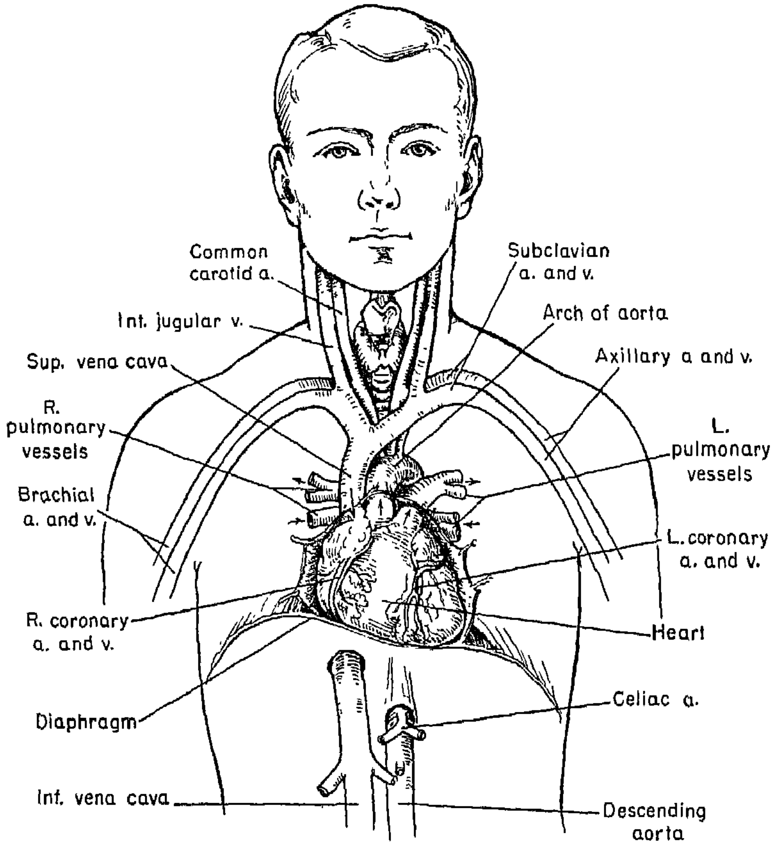
Good circulation means that the flow of blood to each cell (1) is appropriately rapid and full at rest; (2) increases sufficiently during activity; and (3) is unequally distributed in suitable amounts according to the changing needs of the various organs.

Influence of the Heart on Circulation. The heart is the main factor in maintaining good circulation. Contraction of its muscle tissue keeps the blood constantly in motion. The heart contracts at the rate of about 70 to 80 beats per minute when the body is at rest and more rapidly during activity. The rate can be counted at the apex of the heart or at an artery near the surface. Usually the pulse is taken at the radial artery in the wrist. Normally the blood makes the entire circuit from the heart and back to the heart in half a minute. Thus the adult heart pumps blood at the rate of 11 tons per day. The normal heart virtually can do an unlimited amount of work without harm to itself.

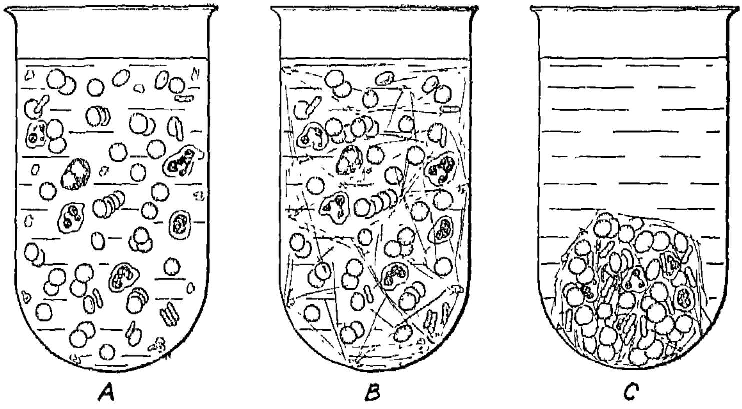
The hygiene of the heart includes, first, making sure that the heart muscle is adequately nourished by a due intake of the necessary nutriment. Second, it includes giving the heart exercise as a muscle. It obtains its exercise while the skeletal muscles are active in work, play, or exercise. Third, it includes giving the heart sufficient rest. The only real rest the heart obtains in a lifetime is between beats. Obviously, the slower its

rate, the more rest it obtains. In health, it obtains enough rest during the periods of inactivity that alternate with activity in the 24-hour cycle. But during illness, especially with fever, which speeds its rate, additional rest is required for the heart. The fourth aspect of heart hygiene is an inclusive one, for all factors that tend to favor general health tend to favor the health of the heart. If for no other reason, all the principles of physical and mental hygiene are of importance. Similarly, if for no other reason, routine physical examinations are desirable to make sure that life is being lived in such a way as to safeguard the heart.

Heart disease from infection and other causes is mentioned in Chapter 13. Functional heart disorder due to nervous causes is mentioned in Chapter 14.



The heart. Note the coronary arteries which supply blood to the heart itself, and the aorta by which blood leaves the heart to supply the rest of the body. The vessels to and from the lungs are the *pulmonary arteries and veins*, while the superior and inferior venae cavae are the large veins which bring blood back to the heart.



The coagulation of the blood. (*A*) Normal blood. (*B*) The formation of fibrin from colonies of thrombocytes enveloping the formed elements. (*C*) The separation into the coagulum and supernatant serum.

Inequalities of Blood Distribution. Organs that arė especially active need more blood than those comparatively at rest, and normally the blood is distributed so as to correspond to the organs' needs. For example, much blood goes to the digestive tract while it is digesting, to the brain while it is being used for hard study, and to the muscles while they are doing strenuous work. The parts less active at the time are temporarily less well supplied with blood. Adjustments usually are made promptly and automatically by the vasomotor nerves (*vaso*, vessel), which cause the capillaries to contract or dilate as may be needed in the parts involved.

To have these favorable inequalities in blood distribution occur as they should, not only must the circulatory system be in order, but also the nervous system and certain endocrine glands whose hormones take part in the process.

Poor Circulation. Poor circulation means either (1) poor general circulation with a slowed rate and force of circulation, or inability to increase the rate and force at need, or both; or (2) unfavorable inequalities in the distribution of blood.

POOR GENERAL CIRCULATION. The heart may be at fault when the rate and force of blood flow are inadequate. The difficulty may lie, however, in disease of the blood vessels, which narrows the space through them, as mentioned in Chapter 13.

Often, however, both heart and blood vessels are normal, and poor general circulation depends upon rather simple factors, the most com-

mon of which is delay in the return flow of blood to the heart through the veins due to mechanical causes.

The return of blood to the heart through the veins from the lower part of the body is against gravity. Passage of blood through the capillaries into the veins is brought about by the oncoming column of blood in the arteries. After the blood enters the veins it can move only onward, because the veins have valves to prevent backflow. Its onward motion normally is aided by pressure against the veins by contraction of the muscles among which the veins lie, and by the suction effect exerted by pressure on the large veins in the chest when a deep breath is taken. Thus, a reasonable amount of exercise, with the muscle contraction and deep breathing it entails, is an advantage to the circulation. Good posture which permits deep breathing is an added advantage.

Any sort of illness or convalescence may cause the venous flow of blood to be slowed and also may temporarily reduce the efficiency of the heart as a pump. Malnutrition, even of a slight degree, may have that effect.

UNFAVORABLE INEQUALITIES IN BLOOD DISTRIBUTION. Whenever the circulation is disturbed from any cause, some organs are likely to become congested with more blood than they need and others to lack a due supply. Apart from disease, such inequalities sometimes occur from a mechanical cause, the force of gravity, as mentioned in the next section.

What Do Blackout, Fainting, and Dizziness Mean? In certain circumstances, much of the blood becomes pooled in the lower part of the body, leaving the brain temporarily less well supplied. This is the cause of "blackout," momentary unconsciousness experienced by aviators after certain maneuvers in which centrifugal force sends much blood from the head to the veins of the legs and lower abdomen. It may be prevented by wearing pressure clothing—antigravity suits—on the legs and lower abdomen, to limit the amount of blood which can collect there.

Fainting is due to a similar faulty distribution of blood. It seldom lasts more than a few moments after the head is lowered. Usually it does not imply an abnormal state of the heart or any other organ. It occurs most often after standing or sitting still for a long time, or it may occur because of the effect of emotions upon the nerves to the blood vessels. Medical advice should be obtained by those who have fainted or have felt faint, since occasionally such an incident has some significance.

Dizziness, also, may be a manifestation of faulty blood distribution, especially when it occurs upon arising after having been lying down a

long time. In such circumstances the blood which has collected in the abdominal veins during rest may not return to the general circulation rapidly enough. Since dizziness may be due to other causes, it is a symptom to investigate.

What Is Shock? Shock is a state of circulatory collapse. Usually it is due to (1) hemorrhage, much blood having left the body (external hemorrhage) or having left the vessels and collected within the body (internal hemorrhage); or (2) so-called "white hemorrhage," which consists of loss of fluid from the circulation, the fluid collecting and remaining stagnant in capillaries or passing out of the capillaries and collecting in the tissues.

The symptoms of shock resemble fainting, except that the individual may remain conscious, and have an extremely weak pulse, shallow breathing, and cold, pale, clammy skin.

Since the volume of circulating blood is greatly reduced, the heart and the vital centers in the brain may be so seriously deprived of blood that they fail in their functions. Death is likely unless blood volume is promptly restored. First aid consists of keeping the victim lying down, to favor circulation to the vital centers, and obtaining medical attention. Transfusion is urgently needed (see p. 59).

Blood Pressure. The term blood pressure is applied to the pressure of the blood in arteries. It is tested by an instrument called a sphygmomanometer, usually applied so as to record the pressure in an artery of the arm. It registers the pressure both at the time the heart is contracting (systolic pressure) and relaxing (diastolic pressure). In healthy adults, systolic pressure usually is about 120 and diastolic about 80, with variations according to sex and size, males and large persons having higher rates.

When blood pressure is lower than average, it does not usually mean ill health; when higher, it may do so, either at the time or in the future, as mentioned in Chapter 13.

Blood Quality

Plasma

The fluid of the blood is largely water, but it contains many other substances vital to life. Among its own normal constituents are protein substances, called albumins and globulins, mineral salts, and fibrinogen. In addition, it always contains nutritive substances from the exterior on

the way to the cells; and waste materials from the cells on the way to the exterior via the lungs and the kidneys. Also, the plasma contains materials produced in various parts of the body and which are being transported for use in other parts. Among these are the hormones from the endocrine glands. Finally, the plasma of a person immune to a given disease contains the particular chemical substances (antibodies) which constitute that immunity, and in all persons the plasma contains substances that take part in reactions against infections.

From time to time the plasma may contain other substances, for whatever enters the body through the digestive tract or the lungs is likely to enter the circulation. Germs normally are not present in the blood but may enter it from an infected area anywhere in the body.

The way in which many harmful agencies harm the body is by changing the characteristics of the plasma. Hygiene as it relates to the plasma involves maintaining its volume and its quality, and this in turn means attention to virtually every aspect of daily life.

Red Blood Cells

Red blood cells are circular biconcave disks, 1/3200 inch in diameter and lose their nuclei shortly after they are formed. They therefore have a short life. The blood normally contains 5,000,000 red blood cells per cubic millimeter. Their chief function is carrying oxygen from the lungs to the cells, as described on p. 42.

Anemia. A deficiency of red cells, or a relative lack of hemoglobin in red cells, or both, causes the disease anemia. The body suffers to some extent from oxygen shortage with consequent impairment of physical and mental vigor. Usually more rapid heart action partly compensates for the deficiency in oxygen carriage, and hence a rapid pulse may be the main symptom in anemia. Pallor of skin and lips occurs in proportion to the deficiency of hemoglobin.

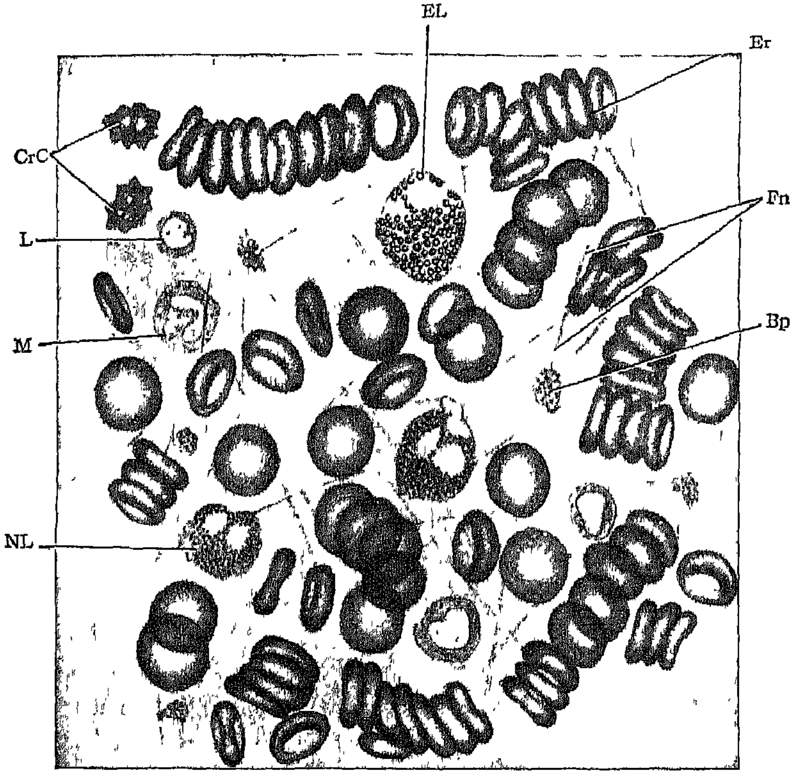
As for causes of anemia, the commonest type—nutritional—is due to a poor diet, especially one that lacks sufficient iron, or to lack of ability to assimilate or absorb a good diet. Another cause of anemia is loss of blood, a large amount at once or a smaller amount continuously or repeatedly, as from excessive or too frequent menstruation or continued slight bleeding from the gums or elsewhere.

Inadequate formation of red cells because of a lack of a substance normally produced in the liver causes a serious type of anemia known as

pernicious. Its name was derived from the fact that it was invariably fatal before it was learned that taking liver or liver extract will keep it in check indefinitely.

Still another cause of anemia is destruction of red cells faster than new cells can be formed. This occurs in malaria in which the parasites enter and destroy large numbers of red cells. Other germs may have a similar effect. So also may certain chemicals, such as lead, and certain medicines, such as the sulfa drugs.

Finally, anemia may be due to abnormal destruction of red cells by the spleen. The spleen is an organ normally concerned with the destruction of old red cells, salvaging some of their iron, and making new cells. It has been called the blood's "repair shop." When it causes splenic anemia, the spleen can be removed, for it is not absolutely essential to life.



Blood. (Er) Erythrocytes. (EL) Eosinophilic leukocyte (CrC) Crenated red corpuscles (L) Lymphocyte. (M) Monocyte. (NL) Neutrophilic leukocyte. (Bp) Blood platelet. (Fn) Fibrin fibers. (Redrawn after Schafer.)

White Blood Cells

The white blood cells, leukocytes, are of several different varieties. Most of them are phagocytes or "devouring" cells, as mentioned on p. 57. Their particular role—that of overcoming infection—will be discussed in Chapter 9.

An increase in white cells, leukocytosis, occurs during most infections. Indeed, the severity of an infection may often be gauged and its progress followed by the count of the white blood cells in a sample of blood. The average number in health is about 6000 to 8000 per cubic millimeter. An abnormal increase in white cells occurs in leukemia, a fatal disease of the bone marrow which becomes excessively active in producing white cells.

A decrease in the number of white cells, leukopenia, occurs in certain infections. In agranulocytosis, the granulocytes, one type of white cell, are destroyed in large numbers. The cause of this disease is most often chemical poisoning by benzene or a benzene derivative, aminopyrine. The latter is contained in many medicines for fever, headache, menstrual pain, or sleeplessness. Even comparatively small doses have caused fatalities.

Platelets

The platelets are minute particles which take part in the clotting of the blood, in connection with fibrinogen from the plasma.

Clotting normally occurs at the point where the blood is shed from the body, provided the flow is not too rapid. Pressure upon the bleeding point aids clotting by slowing the flow. Within the vessels, clotting does not occur unless the vessels or the circulation are abnormal. The harm of a clot within a vessel (thrombosis) is mentioned in Chapter 13. Fibrinogen from the blood plasma may be used to favor clotting in surgical operations and after certain types of accidental injuries.

Blood Groups

Types O, A, B, AB. Everyone hereditarily has blood of a particular group or type, classified as O, A, B, or AB. The four groups were discovered in 1900 by Landsteiner, in research to find out why transfusion of blood from one person to another could not be performed because of the danger of fatal results. He learned that blood of one group causes red cells of another group to dissolve.

Special tests are available to determine the individual's type of blood. Those exposed to hazardous conditions which might lead to the need of transfusion should have their blood group determined, "typed," in advance and recorded on their identification tags. Some persons even have it tattooed on their skin.

Rh Positive and Rh Negative. Recently it was learned that there is still another hereditary grouping of blood according to the presence or absence of the Rh factor. This factor was first discovered in the blood of the rhesus monkey; hence its designation Rh.

Under certain circumstances these two types of blood are incompatible, the result also being a dissolving of red cells. The chief danger is to infants, the destruction of red cells occurring before or just after birth if the mother's blood is Rh negative and the father's Rh positive, or if the Rh negative mother has previously had a transfusion of Rh positive blood. Since this hazard has been recognized and suitable methods have been discovered for preventing it, many infants have been saved from death by erythroblastosis. This condition, hitherto unexplained, has been one of the major causes of infant mortality.

Transfusion

Blood Transfusion. The term transfusion means primarily the transfer of blood from one person to another. The method of transfer is either direct, from vein to vein; or indirect, from vein to container to vein.

Transfusion also refers to the transfer of blood plasma, any fraction of plasma, or red cells. By analogy, it refers also to transfer of other fluids, such as salt solution.

When Is Transfusion Needed? 1. To RESTORE BLOOD VOLUME. The need for transfusion arises especially when blood volume has been reduced by hemorrhage or by shock. Whole blood, blood plasma, or serum albumin from the plasma may be used. Other fluids may sometimes be used in emergencies when the foregoing are not available, but water cannot be used.

Today, transfusion often is done in advance, before surgery, as a means of preventing shock during or after the operation.

2. To IMPROVE BLOOD QUALITY. There are many conditions in which transfusion is needed to restore the quality of the blood in one respect or another. For example, in severe anemia and other blood diseases transfusion of whole blood often is of great value. Similarly, whole

blood may be needed after poisoning by carbon monoxide and some other substances. Whole blood may be given in certain infections for the sake of the immune bodies it contains. Convalescent serum, from a person recovering from an infection, may be used in the treatment of some infections or, if given after exposure and before the disease appears, to reduce the severity or the duration of the attack. Immune globulin, one of the fractions of plasma, contains most of the antibodies normally found in human plasma.

Advantages of Dried Plasma. By a standardized process, whole blood taken from donors is centrifuged to remove its cells and then reduced to a fine powder. When it is to be used, it is restored to liquid form by the addition of sterile water.

Whenever it is a question solely of restoring blood volume, plasma is as useful as whole blood, and in the dried form it has several advantages. First, it can be preserved much longer. In fact, in sealed containers it keeps indefinitely. Second, it occupies little space and can easily be shipped to any corner of the earth. Third, it may be given at once without any delay for preliminary typing, since it is made of the pooled plasma of many donors of various blood groups and therefore is not incompatible with the blood of any group.

Who Should Be Blood Donors? When whole blood is to be transfused, some member of the family often, but not always, will have the right type of blood and be a suitable donor in other respects. To provide for emergencies, hospitals have lists of persons they accept as donors of the various types of blood. These donors are examined often to be certain that their blood will not convey disease. In some communities "blood banks" are maintained where whole blood is preserved for a limited time. Each hospital or individual who draws on the bank is expected to see that a "deposit" equal to the amount drawn out is made immediately.

During the recent wars, the Red Cross conducted blood donor centers for the preparation of dried plasma, and in some regions these will be continued in time of peace. The use of plasma is increasing in civilian medical practice, and donors continue to be needed.

Healthy adults from 18 to 60 years of age are not harmed by donating a pint of blood as often as every three months. Their blood volume is restored almost at once and the full number of red cells in a few weeks, especially if the diet is satisfactory.

4
Taking in Supplies

Oxygen

Oxidation is the main chemical process in the body whereby food materials are converted into energy. Since only a small amount of oxygen is stored in the body, a constant supply must be received from the air. If the supply is wholly shut off, asphyxiation or suffocation occurs at once. A lesser shortage of oxygen leads to anoxia of varying degrees.

Anoxia. Shortage of oxygen in the tissues is called anoxia (*an*, without). It occurs in varying degrees from many causes. The result is impairment of tissue function. Brain tissue is especially susceptible to bad effects from oxygen shortage; even a slight degree may bring about decreased mental ability and adverse changes in personality.

When anoxia begins there is usually an increase in the rate of the heart beat and of breathing in order to take in and distribute more oxygen. This occurs, for example, while a person is "out of breath," temporarily anoxic, after exercise. Shortness of breath and difficult breathing, dyspnea, often are marked symptoms when anoxia is due to abnormal conditions; but in some types of anoxia, as after loss of blood, drowning, and electrocution, breathing does not become faster and deeper but slows even to the point of ceasing.

When the blood is not duly oxygenated it is less red than usual, and this may be evident in a bluish color (cyanosis) of the lips and skin.

Causes of Anoxia. As mentioned, heavy muscular exercise causes a temporary anoxia from which recovery occurs as soon as the oxygen shortage is made up by extra heart action and breathing (see discussion of exercise in Chapter 5). Abnormal anoxia occurs as a result of atmospheric conditions or of bodily conditions.

Atmospheric conditions that lead to anoxia are: first, too little oxygen

in the air; second, foreign gases in the air, such as carbon monoxide which unites with the red blood cells, preventing oxygen from doing so; third, low atmospheric pressure, as at high altitudes, a subject to be discussed in a later paragraph. The first two are never encountered except in artificial conditions; the third is unusual for the average individual.

Bodily conditions which make the body incompetent either to take in or to distribute a full supply of oxygen are of common occurrence. Anoxia may occur in the following conditions. First, anoxia may occur if the respiratory passages are obstructed, as by deformities of the nose, by enlarged tonsils, by adenoids, or by swelling due to the allergic condition, asthma. Second, it may occur if the breathing muscles are weak from disuse or paralyzed by disease or accident. Third, anoxia often occurs when the lungs are diseased and unable to do their work, as in pneumonia. Fourth, if the red cells are deficient, as from hemorrhage, shock, or anemia, a corresponding degree of anoxia occurs. Fifth, the most important cause of anoxia is heart disease, which hampers the flow of blood between the lungs and the tissues. Sixth, damage of the nerve centers controlling breathing is a cause of anoxia, but this cause is especially likely to lead at once to fatal asphyxia. Seventh, certain drugs, especially the narcotics and hypnotics, depress the respiratory center, leading to anoxia and perhaps cessation of breathing.

Preventing Anoxia. To prevent anoxia, it is necessary to avoid the atmospheric conditions, chemical or drug poisoning, or accidents that might lead to anoxia. In addition, any of the bodily abnormalities mentioned above should be corrected if possible.

The average person without abnormalities and in a normal environment can aid in keeping his tissues well oxygenated by attention to the way in which he breathes. Occasional deep breathing helps to keep the chest muscles strong and the chest joints limber and inflates a large proportion of the alveoli. This helps to keep the chest and lungs in condition for full expansion at need. If such breathing does not occur daily as a result of work or play, it should be done as exercise. Furthermore, one should make a habit of breathing moderately deeply and slowly even at rest. Those who habitually breathe in shallow and rapid fashion may chronically suffer from some degree of anoxia at rest and a still greater degree in circumstances that make oxygenation difficult.

Good posture in standing, walking, and sitting is of value as an aid to free action of the lungs and heart, hence in preventing anoxia.

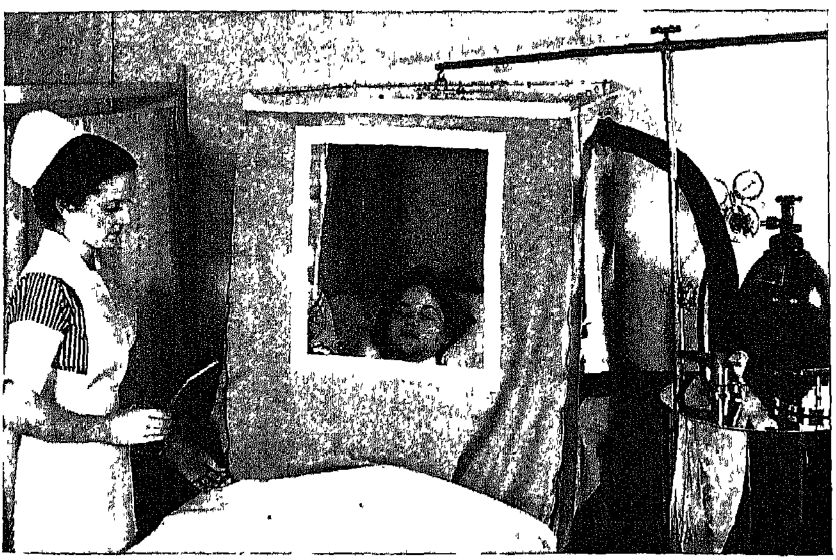
Oxygen in Medical Treatment. Anoxia arising in many conditions re-

quires the administration of oxygen. Examples are: pneumonia, when much of the lung tissue is out of commission; respiratory emergencies arising in heart disease; respiratory difficulties in the newborn, especially those born prematurely; severe hemorrhage; poisoning by carbon monoxide and by certain other chemicals or drugs; as a supplement to artificial respiration, in some cases; and use in conjunction with certain anesthetics, to prevent anoxia from occurring.

Tanks of compressed oxygen are used, and the gas is delivered either by means of a nosepiece or by way of a "tent" surrounding the head and chest of the patient. Sometimes carbon dioxide is used simultaneously as a respiratory stimulant.

What Is Artificial Respiration? When the individual's own breathing motions are inadequate or absent, pressure may be brought to bear on the chest in such a way as to simulate the normal expansion and contraction. This pressure, if properly performed, causes air to enter and leave the lungs, provided the airway is clear, and also tends to cause normal respiratory movements to be resumed.

The Schaefer prone pressure method of artificial respiration is most widely used. It consists of rhythmic pressure at the normal rate of breathing exerted by a second person on the lower back part of the victim's chest. This method is not difficult to learn but can hardly be carried out successfully except by one who has been trained as an expert.



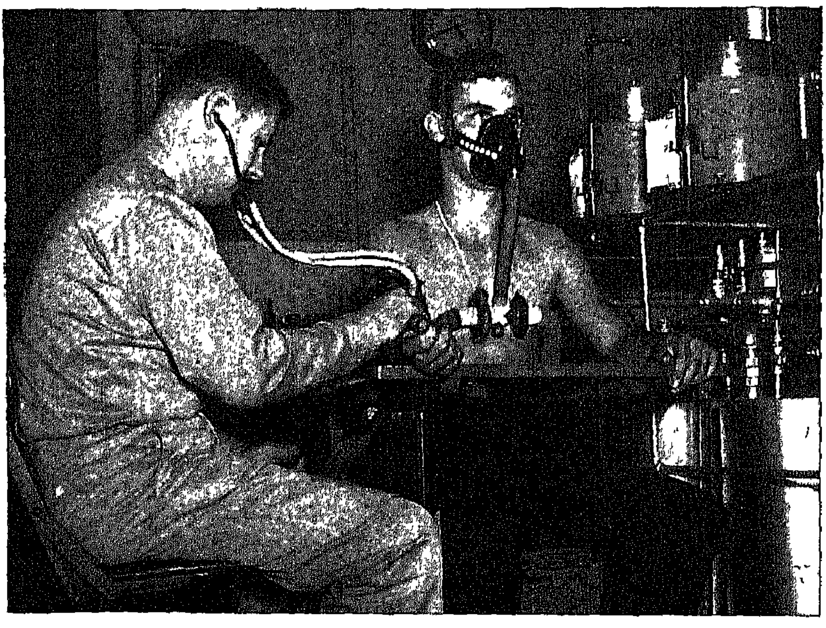
Oxygen tent. (Photograph by Ewing Galloway, N.Y.)

Although most often used for drowning, electrocution, and carbon monoxide poisoning, artificial respiration is of value also in certain other types of poisoning and respiratory emergencies.

Effects of Low Oxygen Pressure on the Body. Above sea level the atmospheric pressure and the partial pressure of oxygen decrease in proportion to the altitude. Anoxia occurs in proportion to the altitude reached and the rate and the duration of the ascent.

1. Residence at High Altitudes. Those who live at high altitudes become physiologically adjusted to prevailing conditions. Heart action and breathing become more rapid to compensate for the smaller amount of oxygen taken in per breath. Also, the number of red blood cells increases; they serve as additional carriers of oxygen. After acclimatization has occurred, the individual lives as comfortably as at lower levels but is not able to do hard work without becoming somewhat breathless.

2. Slow Ascent. Some of the adjustments mentioned take place during a slow ascent, and little or no anoxia occurs. During climbing, however, the muscular activity creates an added demand for oxygen, which often cannot be met. Even a strong person must stop occasionally and,



Tests being done to determine the subject's oxygen requirements and fitness for flying. (Courtesy, U.S. Air Force.)

as high levels are reached, may have to stop to take several breaths before each step.

3. Rapid Ascent. While rising rapidly, there is no time for acclimatization, and not only anoxia but also other symptoms to be mentioned in the next section occur.

What Symptoms May Appear in Flying? As a result of rapidly decreasing atmospheric pressure, three effects may occur.

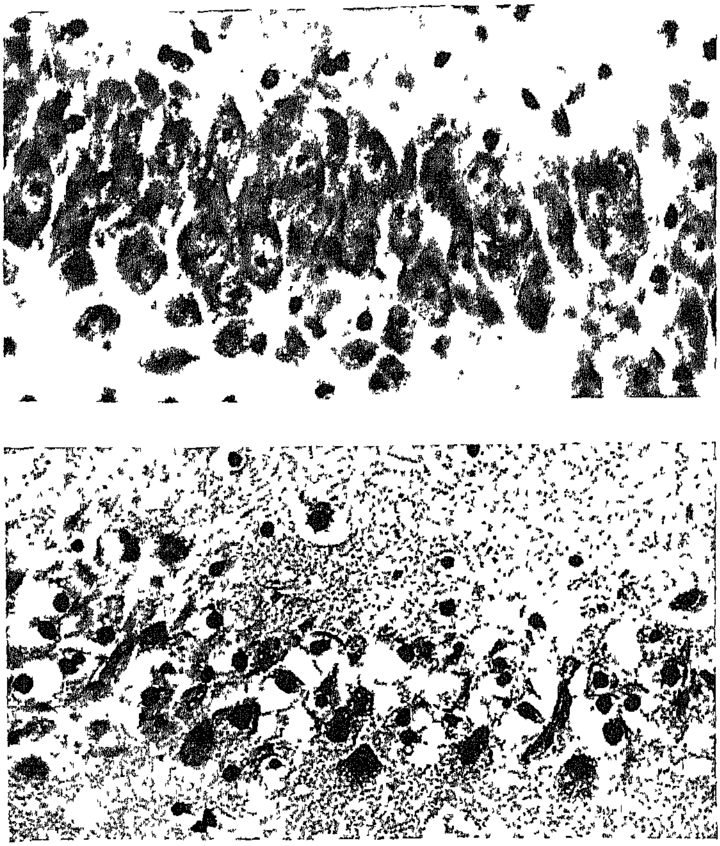
1. Expansion of Gases in Body Cavities. In even comparatively slow ascent, a sense of fullness in the ears may be experienced. In rapid ascent the drum may rupture. Severe toothache may occur from the same cause in a tooth with a pulp infection. In the abdominal cavity, expansion of gases may cause rupture of weak areas, as a recent operative scar, a hernia, or a gastric ulcer. Obviously, the aviator should be in sound condition. Pressure clothing around the lower trunk gives added assistance.

2. Aeroembolism. Gas bubbles may form in the blood, presumably because nitrogen comes out of solution after the blood has been supersaturated with it. These bubbles cause muscle and joint pains, known as "the bends." Rarely, a gas bubble, an air embolus, travels to critical areas such as the lungs, where it occludes the circulation and may cause death. Aeroembolism can be prevented to a large extent by inhalation of pure oxygen before the flight and can be relieved by descent to a lower level.

3. Anoxia. The person who is beginning to suffer from anoxia first breathes more rapidly. Shortly, vision and hearing may be dimmed, and the muscles may twitch. At the same time, the color becomes bluish, and the individual may feel faint. Along with the physical symptoms, mental symptoms occur. The first of these may be exhilaration, a mood of reckless daring, or perhaps moodiness and lack of interest. Time sense is likely to be lost, also the power of attention and memory. Unconsciousness and death would occur if an oxygen supply were not available.

For military flying, strict rules are enforced regarding the occasions when oxygen must be used. It should be used from the ground up, at night, for any flight in which the rate of climb is 2000 feet per minute, for all flights to 15,000 feet, and in numerous other circumstances.

For commercial flying, oxygen is available but seldom has to be used because commercial planes rarely rise rapidly or reach more than 10,000 feet. Unless an individual has been advised to the contrary by his physician, he need fear no harmful results from the low atmospheric pressures in scheduled commercial flights.



(*Top*) Normal and (*bottom*) anoxic brain compared. (Courtesy, Dr. F. H Lewey, Philadelphia, Pa.)

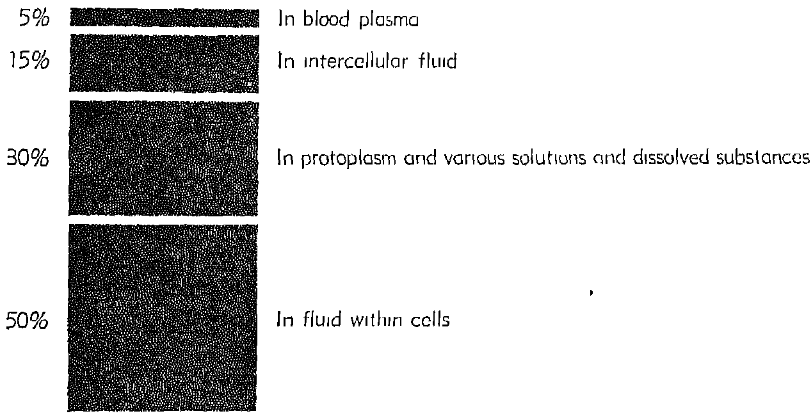
How Does High Oxygen Pressure Affect the Body? Below sea level, as in tunnels, mines, and diving suits, the composition of the air is controlled artificially. As for pressure, the only danger is from aeroembolism if the ascent is made too rapidly. In the case of underground workers, "locks," or decompression chambers, are used to accustom the workers to air pressure lowered gradually.

Water

Water Content and Function. A person weighing 150 pounds normally carries nearly 100 pounds of water. Most of the tissues except bone would have very little bulk if it were not for the water contained in and among their cells. For example, the most highly developed part of the

brain, the cortex, is 85 per cent water; the muscles, 70 to 80 per cent This water in tissues is essential to normal chemical and physical action in them. Indeed, all life processes are favored by a sufficient amount of fluid in the tissues.

The most fundamental need for water in the body is that of maintaining the volume and the fluidity of the blood, otherwise, blood would not circulate readily and would fail to perform its function of carrying materials to and from the cells.



Average distribution of water in the body.

When an excess of water is taken in, the kidneys increase their output. When less water has been taken in than is needed, the output from the kidneys is decreased automatically, and at the same time some of the water in the tissues is turned into the blood stream. The latter adjustment serves to keep up the volume and the fluidity of the blood but leaves the tissues somewhat dehydrated, which is not good for them.

Results of Water Deprivation. Minor degrees of deprivation of water are likely to impair digestion, elimination from the bowels, and possibly kidney excretion. If deprivation occurs to such an extent as to cause much dehydration of the tissues, chemical conditions in the body are altered (e.g., disturbance of the acid-base balance, usually to the acid side; rise in nitrogen in the blood), and many functions are affected adversely.

After the tissues have released as much fluid as possible to the blood, if the blood still is short of water, continued deprivation makes circulation impossible, and death from water starvation occurs, usually in a few days.

How Much Fluid Should Be Taken Daily? The sense of thirst normally indicates how much water is needed. This sense has a local origin in the

membranes of the mouth and throat. They become dry when the system lacks water, but they may become dry under other circumstances (e.g., after talking a long time or after smoking). On the other hand, a person may become somewhat insensitive to dryness of the mouth or may be so preoccupied as to not notice it. The sense of thirst, therefore, is not an absolutely reliable guide to the need for fluid in the system.

The output of water through various channels amounts to about 3 quarts daily (1 pint as water vapor from the lungs; 1 to 4 or 5 pints as perspiration from the skin, the amount varying according to temperature and occupation; 3 pints as urine from the kidneys; a variable amount, usually little, from the intestines; and usually trivial amounts from the lacrimal glands). Therefore, that amount, 3 quarts, must be taken daily.

About 3½ pints of fluid usually are taken daily in food, 1 pint as milk, the remainder, 1½ pints, as other beverages and water itself.

An excess of water does no harm except in certain kinds of illness. In most illnesses with fever, an excess is even desirable. For the average person in health, it is well to take at least 6 to 8 glasses of water a day, as such or as watery beverages, and more in hot weather. Salt is lost as well as water when the body perspires freely, and both should be replaced. Excessive thirst, especially in cold weather, is a symptom to be investigated.

Water at meals is not at all harmful unless taken too cold and in too large quantities at a time or when used to hasten eating.

Food

Nutrition. If the body is not supplied with food life ceases within a few weeks. If it receives some food but not enough or not of the right sort, it weakens. The term good nutrition refers to a state of the body in which each and every cell has received all that it needs to keep it structurally sound and functioning well. A state of malnutrition usually is due to deficiencies in the diet. Sometimes it is partly or wholly dependent upon an abnormal state of health that makes it impossible to take, to digest, or to assimilate enough nutritive material.

A food is any substance which when taken into the body is capable of nourishing it.

Food is needed by the body for three main purposes. First, materials must be taken that will enter into the substance of the body to build and rebuild it—that is, to cause its growth in youth, and throughout life to replace substances given off from the body as a result of its activities.

Second, materials must be supplied that will burn (undergo combustion) and yield heat and energy. Third, other materials that do not serve either of the foregoing purposes must be taken in order to enable the body to make use of the materials taken for construction and combustion; these other substances serve to promote biochemical processes.

All body cells require due amounts of these classes of nutritive materials. The fundamental requirements of all cells are alike, but some have special requirements of their own. Unless the general and special needs of all cells are met, the body cannot be sound nor function normally.

Composition and Nutritive Values

The bulk of any given article of food is one or more of the foodstuffs—protein, fat, and carbohydrate—plus a variable amount of water and, in vegetable food, a varying amount of the fibrous substance, cellulose.

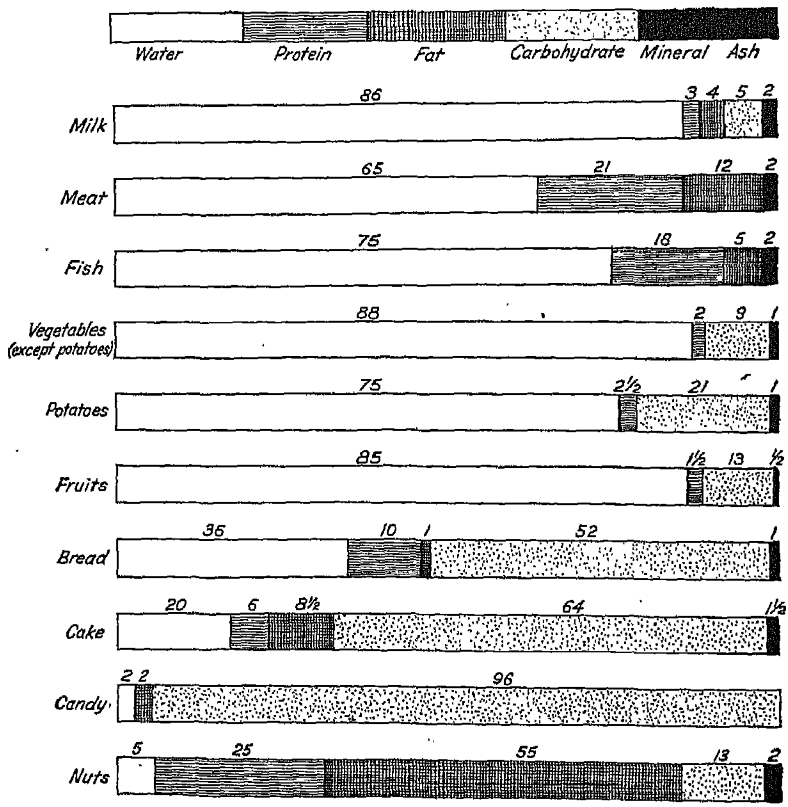


Diagram showing the average percentage composition of certain typical foods.

Contained in the foodstuffs, but not contributing to their bulk, are minute quantities of minerals and still more minute quantities of vitamins.

Of these, protein, fat, carbohydrate, minerals, and vitamins are nutritive. They total 40 substances essential to nutrition. Water is not classed as nutritive, although it is essential to body economy, as stated in the previous section. Cellulose, although a carbohydrate which is nutritive for herbivorous animals, is not nutritive for man because man cannot digest it. Cellulose has value in the diet, however, as will be mentioned in the section on elimination.

Forty Dietary Essentials

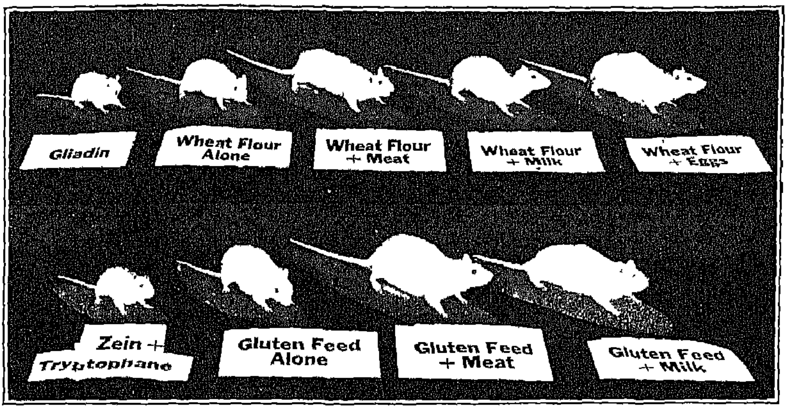
Two of the foodstuffs account for two of the dietary essentials. Carbohydrate (starch and sugar) supplies the body only with sugar (glucose). Fat supplies the body only with fatty acids, all of which appear to be of similar value. The other foodstuff, protein, is in a different category; in the body it becomes amino acids of several different sorts, each of which has specific value in building and rebuilding body protoplasm. At least 10 amino acids are necessary to health and some even to life itself.

In addition, 15 minerals and 13 vitamins are likewise essential. The specific utility of the various essentials will be separately discussed.

Protein Requirement. The prime essential for nutrition is protein, the only nitrogen-bearing foodstuff. Nitrogen is the element that is characteristic of protoplasm—of life itself. From the body a considerable amount of nitrogen is given off daily as a result of metabolism. A similar amount must be taken in to maintain nitrogen balance. Nitrogen cannot be utilized by the body as such, nor in any form except as amino acids, the components of protein food.

As stated, 10 amino acids are necessary in the diet. Some proteins (e.g., those of meat) are "complete" in the sense that they contain all 10; others (many vegetable proteins) are "incomplete," lacking one or more. The body's nitrogen needs may be met by taking meat and several other protein-containing foods daily. (Fish is similar to meat, except that it contains more water.) A diet entirely from the vegetable kingdom must contain more protein and in a greater variety to ensure the necessary amount of all amino acids.

Protein is required by the average adult in amounts ranging from 50 to 100 grams per day. It may be conveniently obtained from the foods shown in Table 6.



Illustrating the variation in the nutrition of rats according to the variation in the kind of proteins in the diet. (Courtesy, Mendel: "Nutrition," New Haven, Yale University Press.)

For nearly all persons there is no danger of taking too much protein. Contestants in Olympic games have been known to take as much as 1000 grams daily. A far greater danger is that of taking too little.

Table 6

PROTEIN IN COMMON FOODS

Food	*Protein, Grams*
Milk, 1 quart	32
Lean meat, 1 serving (or fish, 2 servings)	13–24
Egg, 1	6
Bacon, lean, three 5″ strips	7
Whole grain cereal, 1 serving	4–6
Whole grain bread, 4 slices	6–12
Cheese, American, one 1″ cube	6
Beans or peas, dried, cooked	10
TOTAL	84–103

Fat Requirement. Fat is essential in the diet, for it is a constituent of nearly all kinds of cells. Also, it is of special value as a combustible material. Animal and vegetable fats appear to be of equal value.

Fat occurs in the diet in butter, cream, egg yolk, bacon and other fatty meat and fish, nuts, olives, chocolate, and in foods made with fats, such as gravy, ice cream, cakes, and similar "rich" foods. It should be noted that fat often is present without being apparent as such.

A total of 50 to 100 grams of fat is the average daily requirement, but very active persons may safely take much more fat than sedentary ones.

The daily amount of fat may be obtained conveniently from the foods in Table 7.

Table 7

FAT IN COMMON FOODS

Food	*Fat, Grams*
Milk, 1 quart	35
Butter, 3 large pats	30
Egg, 1	5
Bacon, three 5″ strips	45
Cheese, one 1″ cube	8
TOTAL	123

Carbohydrate Requirement. Carbohydrates are starches and sugars. Starches are abundant in cereal grains, flours, floury foods and potatoes, and present to a lesser extent in all vegetable foods. Sugars occur as cane and maple sugar (as such and in the form of molasses and syrups), the sugar of milk (lactose), of ripe fruits (fructose), of vegetables (sucrose), and in foods sweetened by sugars (beverages and most desserts) or made chiefly of sugar (as candy).

Carbohydrate exists in the body as glycogen or animal starch in liver and muscles and as glucose or animal sugar in the blood. Carbohydrate as such takes small part in forming the body, but it can be converted into fat to form fat tissue. The chief value of carbohydrate is as fuel for combustion.

The amount of carbohydate needed daily varies according to activity.

Essential Minerals. The body tissues contain varying amounts of many minerals. A total of about 30 grams of minerals is lost daily in excreta and sweat and must be replaced. The 15 minerals that are classed as essential in the diet are: iron, calcium, phosphorus, sodium, potassium, chlorine, iodine, sulfur, manganese, magnesium, fluorine, bromine, copper,

cobalt, and zinc. Most of these are required only in small amounts and apparently are quite certain to be present in adequate amounts in any ordinary diet. Even in an abundant diet, however, there may be a shortage of three of these—iron, calcium, and, in some parts of the world, iodine.

IRON. The iron in the body amounts to only one-tenth of an ounce. It is contained chiefly in the hemoglobin of red blood cells. It takes up oxygen from the lungs as the blood passes through lung capillaries and later releases oxygen to the body cells for purposes of combustion in them. Many red blood cells are destroyed daily and much of their iron is excreted. Therefore, a new supply of iron must be taken daily. Shortage of iron produces anemia of the nutritional type.

The average iron requirement for men is 12 milligrams daily. Women need at least 20 milligrams because of the periodic loss of iron in the menstrual flow. During pregnancy and lactation they require even more to meet the needs of the child as well as their own. There is no danger of taking too much iron.

A daily requirement of 20 milligrams of iron may be met from among the foods shown in Table 8.

Table 8

IRON IN COMMON FOODS

Food	*Iron, Milligrams*
Lean beef, 1 large serving	2.5
Liver, beef, 1 large serving	5.0
Oatmeal, 1 serving as cereal	1.3
Egg, 1	1.5
Oysters, 3 large or 6 small	5.0
Apricots, dried, cooked, 8 halves	1.0
Molasses, 4 tablespoonfuls	5.5
TOTAL	21.8

Many other foods, including a large variety of vegetables and fruits, contain smaller amounts of iron.

CALCIUM. A shortage of calcium is a serious handicap to many functions. An elaborate chemical mechanism exists for keeping blood calcium constantly adequate. The layman is familiar with the need of calcium for

forming bones and teeth in youth. Less commonly recognized is the universal need for calcium in virtually all tissues and functions. Sherman has said that a calcium-poor condition probably plays a large part in a number of weaknesses and increased susceptibilities to infection, without being exclusively responsible for any of them.

Some believe that it is not "modern times" but a calcium shortage that is responsible for so many symptoms classed under the heading of "nervousness." Jacques Loeb suggested that without enough calcium we should be "jumping around like jumping jacks all the time."

About 36 grams of calcium are stored in the bones annually up to the sixteenth year, if diet is correct. Thereafter this calcium may be withdrawn in case blood calcium remains too low for a long time.

For normal adults, the daily requirement of calcium is 0.8 gram. The average dietary is said to supply only two-thirds that amount or 0.53 gram. The total daily amount needed by the average adult may be obtained by taking 1 quart of milk per day. Cheese also is an excellent source of calcium; one 1-inch cube supplies one-fourth of the daily requirement. Other foods furnishing calcium are eggs, many vegetables (especially dried beans and peas), many fruits, nuts, and the cereals (especially oatmeal).

IODINE. Iodine is one of the elements that is present in the body in very minute amounts. It comprises only one-three-millionth of the body weight—an amount that could be held on the head of a pin. Yet this small amount is essential to life. Most of it is contained in the thyroid gland, which uses it to make its hormone.

Shortage of iodine causes disorder of the thyroid gland. Usually the gland enlarges, producing goiter, but it secretes less hormone. Mental and physical stunting occur if the disease begins early in life. In adults, metabolism is slowed and with it many functions.

The need for iodine is easily met in regions near the sea, for it is contained in drinking water, sea foods, and food grown in soil near the sea. In inland districts the lack of iodine in the water and in foods grown locally can be met by taking fresh, canned, or preserved food from salt water districts or by the use of iodized salt.

VITAMINS

Vitamins almost deserve a separate treatment as accessory food substances. They are organic compounds, present in minute quantities in natural foods, do not furnish energy, but do regulate energy transfor-

mation and the life activities of animals. Some have been synthesized (manufactured) artificially by man, but most are produced in plants, or to a lesser extent, in the life processes of animals. The first knowledge of them came about the turn of the century. Two diseases were each traced to a specific lack in the diet. The two diseases thus accounted for were xerophthalmia, an eye disease common throughout the world, and beriberi, a nerve disease prevalent in the Orient. McCollum and Davis, two American workers, found that xerophthalmia did not occur in those who obtained a normal fat supply of butter or egg yolk, but did occur in those who used olive oil or lard almost exclusively for fat. Eijkman showed that animals and humans whose chief article of diet was polished rice developed beriberi, but that the addition of rice polishings to the diet prevented and cured the disease. Obviously in each case the disease was caused by the lack of something specific in the diet.

The two substances that exerted such important protective effects were named vitamins (*vita*, life). One was given the letter A and the other B. They were also called *accessory food factors,* and the foods that contained them were called *protective foods.*

Shortly a third vitamin was discovered, which prevented and cured scurvy. It was given the letter C.

Then it was found that the same fats that contained vitamin A also contained another vitamin which protected children against the deforming disease rickets. This was called vitamin D.

Later, vitamin B was found to contain a substance active against pellagra. It was called at that time vitamin B_2 or G.

The First Identified Vitamin Deficiency Diseases. The five diseases just mentioned were classed as deficiency diseases, and each vitamin was given an adjective with the prefix anti- to indicate that it acted against a specific disease. They were:

Vitamin A, antiophthalmic.

Vitamin B_1, antineuritic.

Vitamin C, antiscorbutic.

Vitamin D, antirachitic.

Vitamin B_2, antipellagric.

More recently other vitamins have been discovered and additional information obtained concerning those already identified.

At present, science has specific knowledge regarding many vitamins and their effects upon various animals and upon man. Marked shortage of some of these leads to serious disease, which may be fatal.

One of the most valuable results of research regarding vitamins has been the conclusion that any shortage of vitamins does harm. Even a slight shortage, not so great as to produce one of the specific deficiency diseases, may impair health in various ways. It is believed that large numbers of persons owe their submaximum health to the partial lack of one or more, or all, of the vitamins that are so important in promoting biochemical processes.

Vitamins Known to Be Essential to Man: VITAMIN A. Vitamin A is a growth factor and a specific for the cure and prevention of xerophthalmia (dry eye disease), nyctalopia (night blindness), and hemeralopia (day blindness). It is essential to the normal structure and behavior of epithelial tissue, e.g., the epithelium covering the skin, and forming the lining of the nasal, sinus, and respiratory tracts, mouth, pharynx, entire digestive tract and the genito-urinary tract. Vitamin A may be of value in resistance to infection but only when there has been an exhaustion of body reserves or inadequacy of intake.

Other functions of vitamin A have been reported, but are open to discussion. Only those mentioned are allowable therapeutic claims for vitamin A.

Good sources of vitamin A are liver, cod liver oil, egg yolk, butter, the fat of meat, yellow vegetables, and green vegetables.

VITAMIN D. This is probably a multiple vitamin—a complex. Vitamin D therapy is a specific treatment for infantile rickets, infantile tetany and osteomalacia; for these it is both preventive and curative. An important role of vitamin D in the body is that of regulating the amount of calcium and phosphorus the body uses in constructing bones and teeth (the process being under the direction of the parathyroid glands and an enzyme present in these structures).

Human beings manufacture vitamin D if exposed to sunlight or obtain it by using as food animals whose tissues form vitamin D by the action of sunlight. Good dietary sources of vitamin D are butter, eggs, and milk. The oil from fish livers also furnishes an abundant supply.

VITAMIN K. Vitamin K is found in many foods such as spinach, tomatoes, soybean oil, and enough for the average person is present in a full diet.

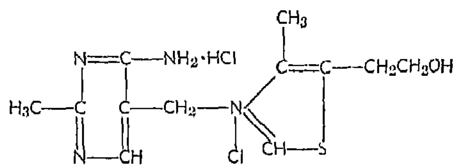
In its crude form vitamin K seems to affect prothrombin. It has an extraordinary protective effect against hemorrhages, and is valuable in jaundice, in some hepatic diseases, and certain intestinal diseases such as ulcerative colitis and celiac disease.

VITAMIN C OR ASCORBIC ACID. Scurvy occurred in epidemic proportions during the Middle Ages. It wrought great havoc among the Crusaders and the crews on the voyages of discovery. It cost Vasco da Gama 100 of his crew of 160 on his voyage around the Cape of Good Hope.

About 200 years ago officers in the British Navy discovered that scurvy could be prevented by lime juice. The slang term "limey" has been applied to English sailors ever since, and the citrus fruits (oranges, lemons, grapefruit, and limes) have since been used to prevent scurvy. Besides its especial abundance in citrus fruits, almost any vegetable contains some.

VITAMIN B COMPLEX. The vitamin first described as vitamin B is now known to be one of a group called vitamin B complex. Claims for vitamin P–P, vitamin B_1, vitamin B_2, and vitamin B_{12} have been accepted by The Council on Pharmacy and Chemistry of the American Medical Association.

VITAMIN B_1 (THIAMIN). There is definite evidence of the necessity of vitamin B_1 for normal carbohydrate metabolism, for maintenance of general body tone, for lactation and prevention of certain types of neuritis. Thiamin in its natural state is scarce, occurring sparingly in yeast and pork, but it is manufactured synthetically and cheaply today.



Thiamin chloride.

VITAMIN B_2 OR G (RIBOFLAVIN). Riboflavin deficiency is responsible for certain eye troubles characterized by itching, burning, and a sensation of roughness of the eyes. These symptoms are relieved promptly by the administration of riboflavin. Another of its basic functions is growth control and nutrient metabolism and it protects against pellagra. It is found in lean meat, yeast, eggs, milk, and some vegetables.

VITAMIN B_{12}. It is now known that vitamin B_{12} is the true red blood corpuscle maturing factor. Thus it is used in pernicious anemia, sprue, and nutritional anemia. One microgram a day is all that is necessary for maintenance. Its source is the liver.

NIACIN OR VITAMIN P–P. Niacin is a specific for the disease known as

Pellagra. Male. Symmetrical lesions on face. Similar lesions occurred on tongue and palate. Mouth presented atrophy of tongue papillae, extreme redness of mucous membranes, gingival inflammation, and white membranous particles beneath tongue and on buccal parietes. Case terminated fatally. (Courtesy, D. T. Smith.)

pellagra. The terms niacin and niacinamide are now officially recognized as synonyms for the chemical names "Nicotinic acid" and "Nicotinamide."

Other Vitamins: VITAMIN E (TOCOPHEROL). Vitamin E must be included in the diet of rats to insure successful reproduction. There is no conclusive evidence to show that vitamin E is necessary to reproduction in human beings, in fact, there seems to be agreement that the vitamin is of no value in the treatment of sterility. There is interest in vitamin E in connection with the possible treatment of some cases of degenerative diseases. It occurs in the oils of various seeds, lettuce, and alfalfa.

The Basic Seven Plan of the Food and Nutrition Board of the National Research Council. Serve daily at least one item from each of the following groups:

Group I. Green and yellow vegetables. One raw, one cooked, frozen or canned.

Group II. Oranges, tomatoes, grapefruit, or raw cabbage or salad greens.

Group III. Potatoes and other vegetables and fruits. Raw, dried, cooked, frozen or canned.

Group IV. Milk and milk products. Fluid, evaporated, dried milk, and cheese.

Group V. Meat, poultry, fish, or eggs. Or dried peas, beans, nuts, or peanut butter.

Group VI. Bread, flour, and cereals. Natural whole grain, enriched, or restored.

Group VII. Butter or vitamin A fortified margarine.

THE DAILY DIETARY: QUANTITY AND ASSORTMENT

How Important Is the Diet? In the decade 1927 to 1937, a vast amount of new knowledge was gained about essentials of diet. Obviously, it was important that the new knowledge be applied throughout the world. Accordingly, in 1937–1938, the nations of the world

Table 9

APPROXIMATE FOOD VALUE OF DAILY ALLOWANCE FOR A MAN, MODERATELY ACTIVE AND WEIGHING 70 KG.*

Calories	3000
Protein	70 Gm.
Calcium	0.8 Gm.
Iron	12.0 mg.
Vitamin A	5000 I.U.
Thiamin (B_1)	1.80 mg.
Riboflavin	2.70 mg.
Niacin	18.0 mg.
Ascorbic acid	75.0 mg.
Vitamin D	400 I.U.†
B_6	unknown for man
Pantothenic acid	unknown for man
Biotin	unknown for man
Vitamin E	unknown for man
Vitamin K	unknown for man

* National Nutrition Conference for Defense, Washington, 1941.
† Available from exposure to sunlight, but if not, 400 I.U. is satisfactory.

coöperated through the League of Nations in a Survey of National Nutritional Policies, first, to discover what sort of diets the people actually were taking and, second, to consider how dietaries could be brought to the new high standards.

As a result of the Survey, it was estimated that four-fifths of the world's population was not adequately nourished. Even in this country, free from famine and war, the United States Committee to the conference reported that "from 40 to 60% of the diets of white families in the four regions from which most extensive data were obtained were found to be in need of improvement."

It was realized that malnutrition was perhaps the most serious problem confronting all peoples. Nutrition experts declared that "faulty diet is responsible for a great deal of disease, ill health, and physical disability which in the past were regarded as normal and inevitable."

By 1941 the problem of malnutrition had become even more urgent. As stated in the *Military Surgeon* for January, 1941, "National defense hinges upon sound national health, which in turn depends upon sound nutrition. The issues of modern war may well be decided on the home front, victory going to the nation which can show the greatest stamina and endurance."

Government officials planning for our national security have placed the matter of better nutrition at the top of the list of the urgent health problems of our times and possibly as the most vital of all our defense problems.

Causes of Poor Diet. When the diet is not adequate it is usually because the total intake is too meager in amount and because the small amount taken happens to lack essential substances. This often occurs in those who lead sedentary lives and have no very great demand for food. Also, it occurs in those who eat little because of poor appetite due to illness; in those who deliberately reduce the diet in order to reduce weight; and in those who have marked taste preferences (e.g., for sweets) to which they yield in defiance of nutritive needs.

Regarding poverty as a cause of poor diet, the aforementioned report of the United States to the League of Nations committee stated, "It is interesting to note that the quality of the food supply selected by families was by no means only a matter of level of food expenditure, for at every expenditure-level above a certain minimum, some families succeeded in obtaining good diets, while others procured only fair or poor from the standard of nutritive value. Of every 10 white families spend-

ing enough or more on food to purchase adequate diets, only from 2 to 4 selected good or very good diets."

Excluding extreme poverty and actual food shortage, the commonest reason for taking a poor diet is lack of knowledge of what is essential to health. Many people still believe that a diet consisting largely of meat, potatoes, bread, and pie is "strengthening." Others, influenced by modern knowledge of vitamins, go to the opposite extreme and center the diet around salads and fruit, disregarding the need for protein.

Minimal, Adequate, and Optimal Diets. These three terms are used to distinguish between a diet that (1) barely prevents disease (minimal); (2) a diet that maintains a "passable" degree of health (adequate); and (3) a diet that gives buoyant health and abundant vitality (optimal).

Much experimentation has been done to determine precisely what constitutes an optimal diet for man. In the laboratory the animal used in nutritional studies is the rat because the chemistry of its nutrition is very similar to that of man (except that it does not rely so heavily on vitamin C). Since the life cycle of the rat is only one-thirtieth as long as that of man, many generations can be studied in a short time. Also, they are so small that large numbers of them can be kept and studied in the laboratory at one time.

In one series of experiments, rats fed the customary diet of man in a superior community died so rapidly that the experiments could not be continued. Certain additions to the diet enabled many of them to survive until they were subjected to gastrointestinal infection; 60 per cent contracted the disease and died within 160 days. Still further additions to the diet enabled 97 per cent of the rats to keep well when exposed to infection and to still be alive on the 160th day.

In many other experiments it has been found that an optimal diet

Research in nutrition and longevity. Ages of rats the same, diets different. (Courtesy, Rockefeller Foundation.)

increases the life span of rats and enables them to continue longer in the vigorous period known as the prime of life.

It is fitting to dream of the race of supermen that might exist if all human beings could be as genuinely well nourished as experimental rats on an optimal diet.

To summarize, an optimal diet is one that gives these results: (1) growth and development to maturity is rapid and complete; (2) a high level of adult vitality is attained; and (3) expectation of life at all ages is greater than in those less well fed.

In planning a dietary it is necessary, first, to decide what the total amount of food should be per day and, second, to choose an assortment of foods that together meet all nutritive needs. In other words, the quantitative aspects of diet must be considered, and then the qualitative; one must have not only enough food, but also the right food.

Computing the Total Amount of the Diet

The Necessary Amount of Food. The total amount of food taken daily must equal the total amount of energy expended daily. To arrive at the precise amount, it is necessary first to know the energy value of the various foods, and second the amount of energy used by the individual in question in his various activities. These two quantities must then be matched; so much energy use, so much energy-yielding food.

The one fact about food that is most generally understood is that food is the fuel which furnishes the body with energy. Food is recognized as comparable to the gasoline that runs a motor. It ignites in the presence of oxygen and burns, yielding heat and at the same time a supply of energy. The gasoline engine uses the energy at once; the body uses it at once or stores it as potential energy for future use.

Just as a certain amount of gasoline is required to enable an automobile to travel a certain number of miles, so also is a certain amount of food necessary to enable the body to exhibit a given quantity of energy, motor and otherwise.

All three of the foodstuffs are combustible. When burned, outside the body or in it, they yield heat and energy in measurable quantities. The unit of measurement is the calorie. One calorie is the amount of heat that will raise 1 gram of water 1° C. Because the output of heat and of energy correspond, the calorie can be used as the measure of the energy made available by combustion.

Protein and carbohydrate each yield 4 calories per gram, and fat yields 9.

In What Quantities Does the Body Use Energy? It can be determined by laboratory methods how much energy is used in various activities. The amount of combustion is calculated by measuring the amount of oxygen used and the amount of carbon dioxide given off.

The body uses a minimum of energy for sustenance of internal vital processes. This amount is known as the basal requirement. The basal metabolic rate is measured while the body is lying at rest, not even digesting food. It has been found that women use about 65 calories per hour under basal conditions, and men about 75 calories.

The amount of energy used in various activities can also be measured. Some of the amounts are given in Table 10.

Table 10

CALORIC REQUIREMENTS ACCORDING TO ACTIVITY

Activity	*Calories per Hour*
Writing at desk	100
Standing at rest	105
Singing	120
Typewriting, moderate speed	125
Carpentry, light	240
Walking, briskly	300
Sawing wood	475
Running, 5 to 6 miles per hour	570
Digging excavations	600
Football	600

Individual Caloric Needs. First, the larger the individual the more energy he must use for sustenance. Basal metabolism varies with the surface area of the body.

Second, caloric needs vary according to the need for bodily growth. In childhood, extra calories are needed in proportion to surface area to provide for such growth.

Third, caloric needs vary at any age according to the need for increasing or decreasing the amount of fat on the body.

Having in mind the foregoing possible variations from average requirements, the individual may thus compute caloric needs:

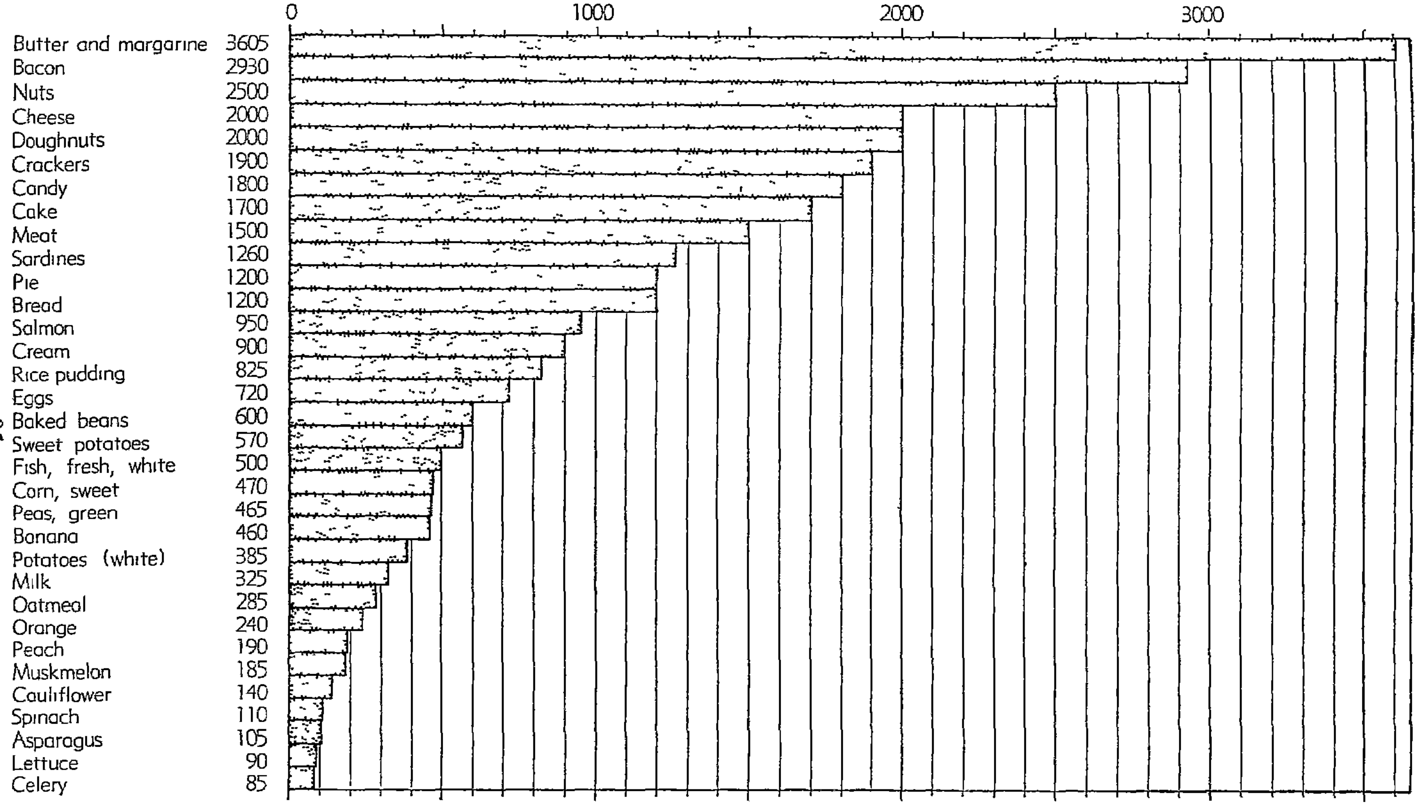
	Hours		*Calories*		*Calories*
Sleeping, 8 hours	8	×	65	=	520
Sitting at meals, 2 hours	2	×	100	=	200
Sitting in classroom, 4 hours	4	×	100	=	400
Sitting at study, 4 hours	4	×	100	=	400
Sitting at other occupations, 2 hours	2	×	100	=	200
Walking leisurely, 1 hour	1	×	170	=	170
Tennis, moderate speed, 2 hours	2	×	350	=	700
Dressing, bathing, etc , 1 hour	1	×	120	=	120
	24				2710

Foodstuffs and Caloric Needs. From the point of view of furnishing heat and energy, the foodstuffs protein, fat, and carbohydrate are interchangeable, though they are not interchangeable from other nutritive points of view. As has been shown, protein in given amount is absolutely essential to life. However little the activity, the protein requirement remains the same. Minimum amounts of fat and of carbohydrate also are necessary. Thus the diet should consist of each of the three foodstuffs. The amount of carbohydrate is the most elastic of the three, being subject to the need for more or fewer calories.

Foods vary in their proportions of the three foodstuffs. Also, they vary in the degree to which they are diluted by water and made bulky by cellulose—each of which decreases their relative food value. For example, to obtain a total of 2000 calories from lettuce (largely water and cellulose) it would be necessary to eat 23 pounds, whereas it would be necessary to eat only one pound of cheese (containing much fat, little water, and no cellulose).

Obviously, it is essential that one be familiar, in a general way, with the relative proportions of the three foodstuffs in the common foods, as shown in the diagram on p. 85.

A child should gain weight; an adult who has reached his normal weight should remain there. Usually the total daily quantity of food may be assumed to be correct if these conditions are maintained. But correct weight indicates nothing of the adequacy of nutrition in its



The number of calories per pound furnished by some of the common foods

Table 11

QUANTITIES OF FOOD YIELDING APPROXIMATELY 100 CALORIES*

Meat, average lean, small to medium serving

- Bacon, 4 or 5 small slices
- Frankfurter, 1
- Hamburger, 1 medium
- Lamb chop, 1

Fish, average, large serving

- Clams, 12 medium
- Fishcake, 1 large
- Lobster, small serving
- Mackerel, medium serving
- Oysters, 12 medium
- Salmon, small serving
- Sardines, 3 to 6

Eggs, 1 very large

Vegetables, without additions

- Asparagus, 20 stalks
- Beans, baked, ⅓ cup
- Beans, string, 2 cups
- Beets, 1⅓ cups
- Cabbage, raw, shredded, 5 cups
- Cauliflower, small head
- Corn on cob, 2 small ears
- Cucumbers, 3 medium
- Lettuce, 2 large heads
- Onions, 3 to 4
- Peas, green, ¾ cup
- Potato, white, 1 large
  - sweet, ½
- Radishes, 36
- Spinach, 2½ cups
- Tomatoes, 4 medium

Fruits, fresh, without additions

- Apple, 2 medium
- Banana, 1 large
- Blueberries, 1 cup
- Cantaloupe, 1 small
- Orange, 1 very large
- Peach, 3
- Pear, 1 large
- Strawberries, 1⅓ cups

Fruits, dried

- Dates, 3 large
- Figs, 1 large

Cereal, without additions

- Average dry, flaked or puffed, 1¼ to 1¾ cups
- Cooked oatmeal, 1 cup

Dairy products

- Butter, 1 large pat or 1 level tablespoonful
- Cheese, American, 1½-inch cube
- Margarine, same as butter
- Milk, 1 small glass (⅝ cup)

Bread and crackers, without additions

- Bread, white or whole wheat, thick slice, medium size
- Corn bread, piece 1 by 2 by 2 inches
- Graham crackers, 2
- Griddle cakes, 1 (diameter, 4½ inches)
- Saltines, 6
- Waffle, ½ (diameter, 6 inches)

Desserts

- Cup custard, ⅓ cup
- Doughnuts, ½
- Fudge cake, piece 2 by 2 by 1 inches
- Ice cream, average, 2½ heaping tablespoonfuls
- Macaroons, 2
- Pie, 9-inch diameter
  - apple, 1½-inch sector
  - custard, 2-inch sector
  - lemon meringue, 1-inch sector
  - mince, 1-inch sector
  - squash, 2-inch sector
- Rice pudding, medium serving
- Sherbet, ½ cup

Nuts

- Peanuts, 12 double
- Peanut butter, 2½ level teaspoonfuls
- Walnuts, 8 to 10

Candy

- Caramel, 1
- Chocolate, peppermint, 1 medium
- Fudge, 1 large piece

Table 11—(Continued)

Accessories

Butter, 1 large pat or 1 level tablespoonful
Cheese, American, 1½-inch cube
Chocolate sauce, 1 tablespoonful
Chocolate nut sauce, ½ tablespoonful
Cream, light, ¼ cup
Cream sauce, ⅓ cup
Margarine, same as butter
Marmalade, 3 teaspoonfuls
Maple syrup, 1½ tablespoonfuls
Mayonnaise, 1 tablespoonful
Milk, ⅝ cup
Olive oil, 1 tablespoonful
Sugar, 2 dominoes or 2 level tablespoonfuls

Beverages

Cocoa, average, ½ to 1 cup
Cola drinks, ½ to ¾ cup
Coffee, black, none
Ginger ale, ¾ large bottle
Grape juice, ½ cup
Lemonade, sweetened, 1 large glass
Milk, ⅝ cup
Milk "float," ⅓ large glass
Milk shake, ½ large glass
Orange juice, 1 cup
Tea, without additions, none

* Quantities cannot be exact since the composition of foods and the size of servings vary. Note that the table does not take into consideration the "high calorie" additions to food as served, such as butter, cream sauce, gravy, mayonnaise, sugar, cream, and the like.

broadest sense. One may gain weight or remain the same weight on a diet that provides scarcely anything but calories.

Correct Assortment of Food

Ensuring Good Nutrition. To become familiar with all the properties of foods and all the specific nutritional needs of the body is a matter of professional study. The layman does not require the same detailed knowledge in order to provide himself with an optimal diet. Large numbers of people can rely upon professional knowledge used in their behalf by nutritionists and dieticians; this is the case, for example, with those in the Army and the Navy, in college dormitories, and in various institutions. Such persons should be well nourished if they actually do eat the assortment of foods scientifically provided for them.

Individuals who choose their own diet require a little more information, but not a great deal. The following scheme—the nine-point diet—has been devised as a simple way of meeting nutritional needs.

The average adult partaking of one item each, in appropriate quantities, from each of the following nine groups, and making variations within such groups as are subject to variation, will be likely to supply himself with all of the (40) dietary essentials—and to be well nourished.

1. Meat (or fish, fowl, or game). At least one serving daily.
2. Milk, as such or in or on food. At least 1 pint daily.

3. Milk products (butter, cheese). Butter on bread or in food; cheese, as such or in food (cream, American, etc.).

4. Eggs. At least one a day.

5. Whole grain cereal. As cereal, at least one serving daily; as dark bread, in appropriate amounts according to caloric needs.

6. Green leaf vegetables (lettuce, celery, and the various "greens"). At least one serving daily.

7. Root vegetables (potato, carrot, turnip, etc.). At least one serving daily.

8. Legumes (beans, peas, lentils, soy beans). At least one serving daily (except when other good sources of minerals and vitamins are taken in large quantities).

9. Fruits, including the fruits taken as vegetables (tomato, cucumber, avocado, squash, etc.), fruit juices, and berries. At least two servings daily, one of which should be citrus fruit or tomato.

Additional foods usually are necessary to make up the full caloric requirement. They may be taken practically according to preference, but it is desirable to choose them from the same list or from foods combining those in the list.

Are Other Combinations of Food Satisfactory? It should be understood that there are hundreds of combinations of foods that meet nutritional needs, and that the layman should not be suspicious of professionally planned diets not in the least resembling a diet chosen according to this scheme. For example, a noted physiologist computed that nutritional needs would be met and 2000 calories provided by a diet of 5 slices of dark bread with butter and molasses, 1 quart of milk, 2 eggs, and lettuce.

Rations in the presence of food shortage must be carefully planned by experts. Without enough meat and eggs, it is possible to be well nourished on diets based upon soybeans and cheese (both rich in protein and calcium), whole wheat bread, potatoes, whatever other vegetables are available, and skim milk. For emergencies, such diets may be satisfactory for nutrition and satisfying to the palate.

When Special Advice Is Needed. It requires special care to devise a diet restricted in quantity or variety and at the same time nutritional. Professional advice should be secured under any circumstances that prevent a person from taking the variety of foods mentioned in the nine-point diet.

The layman should not, on his own initiative, omit the foods that

supply vitamins and minerals and instead take medicinal preparations containing them. Valuable as the latter may be upon occasion, food is the best source of nutriment of all sorts. Undoubtedly food contains needed substances that have not yet been discovered and are not present in the various vitamin preparations.

It should be unnecessary to say that all food fads are dangerous. If any of them had scientific merit, they would be advocated by experts in nutrition whose life work is that of determining what foods man needs.

What National Solutions Are Being Attempted. There are certain possibilities of large-scale improvement in nutrition by improving the nutritive qualities of foods. First, attempts are being made to ensure the mineral values of foods by regulating the composition of the soil in which they are grown, and the nutritive values of animal products by attention to the nutrition of livestock.

Second, experiments are taking place regarding the processing of foods, to ensure against depriving them unnecessarily of any nutritive values they contain in the natural state. Canners have developed methods that make all canned foods nearly as rich, and often more rich, in minerals and vitamins than fresh food cooked by ordinary domestic methods.

Third, there is the possibility of fortifying foods that are necessarily changed by processing, by adding to them the substances removed. To make the white flour that the public appears to prefer for bread, the natural vitamins and minerals of wheat are removed. Since white bread is consumed in such large quantitites, it has seemed important to restore its missing values, and in 1941 "enriched" white flour, containing added vitamin B and iron, and "enriched" bread made of such flour were put on the market.

Another modern method of fortifying foods consists of increasing the vitamin D content either by irradiation or by adding the vitamin itself. This is practical and safe in the case of milk. Also, a low-cost substitute for butter, oleomargarine, is made more nearly like butter by adding vitamins A and D. Another fortified food is table salt to which iodine is added for use in the goiter regions.

One difficulty in adding vitamins to foods is that unless their uses are quite carefully controlled, persons might be led to rely on a food in which the vitamin is not potent enough to be of any value. A difficulty in regard to minerals is that an excess might be as harmful as a deficiency; some minerals would simply be excreted if taken to excess, but others would damage the body chemistry.

Today, all of these problems are being studied in many laboratories, including the National Institutes of Health of the U.S. Public Health Service.

In the meantime, government attempts are being made along educational lines to increase public knowledge about the choice of a daily diet. Corresponding in a general way with the nine-point diet described on p. 87 is the Basic Seven, the federal government's grouping of essential foods.

DIGESTION

A well person as a rule can digest a reasonable amount of any of the common foods—that is, he can easily and comfortably turn the food he eats into absorbable nutriment. Yet vast numbers of people suffer more or less frequently from "indigestion"—a term which means difficulty arising from the process of digestion.

To make sure that digestion regularly takes place satisfactorily, two factors must be considered. The first is the digestive power of the individual, as influenced by health and habits. The second is the relative digestibility of foods.

Digestive Power

Does Health Affect Digestion? It is equally true that good health favors good digestion and the good digestion favors health. This is a benign circle. On the other hand, almost any form of illness is likely to weaken digestive power by affecting the motor or secretory powers of the stomach and intestines.

Obviously, indigestion would be expected to result from diseases of the digestive tract, such as appendicitis, gall bladder disease, and peptic ulcers. It may be a symptom, also, in any acute febrile illness, anemia, tuberculosis, malnutrition, and overfatigue.

A correct diet may be essential to recovery from any illness that disturbs digestive powers. According to circumstances, it is necessary either to eat no food at all until a diagnosis has been made (as when appendicitis is suspected); to follow a diet prescribed by the physician; or, in trivial disturbances, to modify the diet one's self, so as to include only the more easily digestible foods mentioned on p. 94.

Nerves and Digestive Power. Even the normal stomach can be greatly deranged by receiving disturbed nerve impulses. The fact that emotional disturbances affect the digestive tract can be demonstrated in the labora-

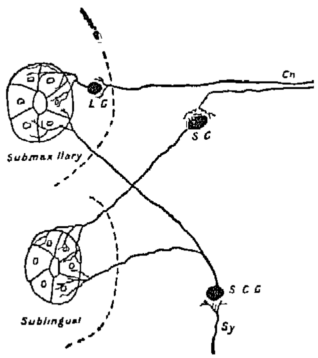
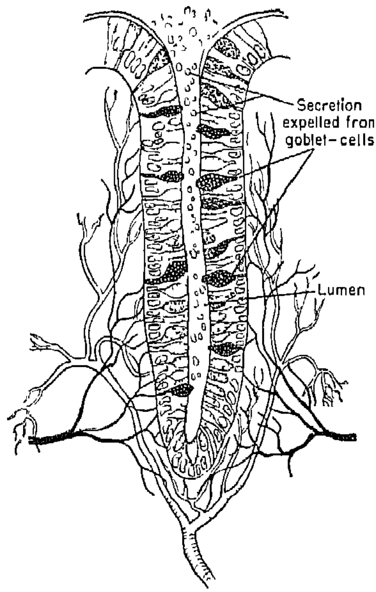


Diagram of salivary glands with the secretory nerves that supply them with impulses. (Cn.) A cerebral nerve. (Sy) A sympathetic nerve. (L.G., S.G., and S.C.G.) Nerve ganglia.



A gastric gland with its blood vessels. Note the product of the gland in its lumen.

tory. If an animal is given a meal containing an opaque substance such as barium and the progress of digestion observed by the use of the fluoroscope, it will be noted that if the animal becomes excited (as in the case of a cat seeing a dog), motion in the digestive tract stops. By other methods it can be shown that secretion of digestive juices is also disturbed in response to excitement or mental distress.

"Nervous indigestion" is commonest in those of nervous, tense, or excitable temperament. Usually it is due either to lack of emotional balance, or to being "on the go" too steadily, or to both. Some authorities believe it to be the commonest cause of chronic indigestion and even of gastric ulcer.

Meal Habits and Digestive Power. A feeling of hunger is not necessarily a sign that one should eat. Hunger is due to rhythmic contractions of the stomach. Normally, it appears only when the stomach is empty or nearly so, but it may occur earlier, especially in those whose stomachs empty rapidly or secrete too much hydrochloric acid, or who develop the habit of eating frequently.

For many persons, digestion appears to be best when meals are taken regularly, usually at about 5-hour intervals. In some cases, shorter inter-

vals are more satisfactory. It is usually unsuitable to take food between meals except when such food is taken regularly as an extra meal and when the extra meal consists of foods that do not remain long in the stomach nor tax its energy.

Because baths at other than body temperature and vigorous exercise draw a considerable amount of blood away from the digestive tract, these activities should not follow meals for at least an hour, or digestion will be hampered. A smaller interval will suffice before meals to prepare the stomach for its digestive work.

From what has been said regarding nerves and digestion, it will be apparent that meals should be eaten in calm. In many domestic groups, mealtimes are mistakenly made the occasion for argument, mutual criticism, and the settling of individual, group, and even national and international problems.

Meals should not be omitted at regular mealtimes except after overeating at the previous meal or when certain symptoms of illness are present (e.g., abdominal pain, which might be appendicitis). In general, when "too tired to eat" or "too sick to eat" one requires as much food as usual but of an easily digestible sort.

Appetite and Digestive Power. In general, foods one desires will be better digested than others because the flow of digestive juices is promoted by the appetite. The mere sight or smell of food may make the mouth "water," and this in turn starts the flow of digestive juices in the stomach, making it also "water." Digestion can then begin as soon as food is eaten.

One of the main reasons for spacing meals rather widely and not eating between meals is that thereby one may have a chance to generate an appetite.

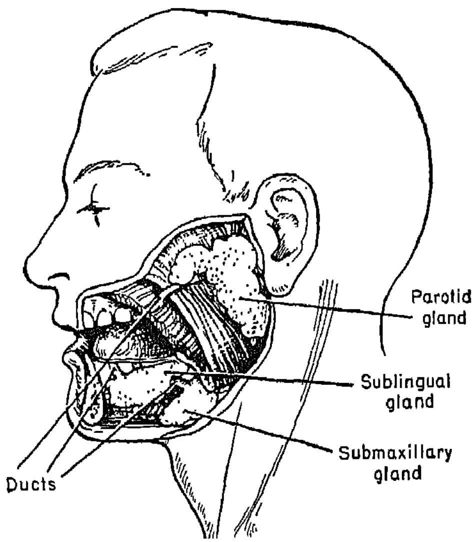
Although lack of appetite may be due to almost any disorder of body or mind, common causes are lack of vitamin B in the diet, lack of sufficient exercise, overfatigue, and disturbing emotions.

Other Factors Affecting Digestion: SMOKING. Physicians quite generally agree that smoking may be a factor in causing indigestion and in preventing its cure. The explanation usually is that smoking increases the acidity of the gastric juice up to a point where it becomes an irritant. The bad effects of tobacco are more pronounced after smoking "on an empty stomach."

EXERCISE. The person who has sufficient exercise daily is likely to have a better appetite and greater digestive power than the sedentary person

cooped up within four walls. Athletes seldom carry around with them little bottles of pills. Much of the benefit of exercise is its activation of circulation throughout the body, including the digestive tract. Other benefits come through exposure to sunlight and through improved nervous stability.

POSTURE AND CLOTHING. Those who stand and sit erect allow all available room for the abdominal organs to remain in their proper position and to function normally. In stooping posture, there may occur enough cramping of the stomach and intestines to interfere both with



The salivary glands and their ducts.

digestion and elimination. If the digestive organs are crowded downward, circulation to them may be impaired and their normal peristalsis limited. Tight clothing around the waist may have a similar mechanically hampering effect with similar physiologic hampering.

SIZE OF MEALS. The sense of satiety is as valuable as the sense of hunger. A common cause of indigestion is the overloading of the stomach. In such a case, the stomach may be impelled to empty itself, causing nausea and vomiting. If not, discomfort may ensue from distention with gases and the like and may continue until the offending food has finally passed through the entire digestive tract.

SWEETS. The term sweets is applied to all strongly sweet foods (such as candy, ice cream, most desserts, jam, and the like). These should pref-

erably be taken only during a meal or at the end of a meal, after other foods are already present in the stomach, for concentrated sweets in some persons may be irritating to the membrane lining the stomach.

Also, if taken between meals sweets may inhibit the appetite for other foods and thereby affect both digestion and nutrition, The milder sweetness of fruits does not have that effect.

Digestibility of Foods

Most of the foods in common use will be digested sooner or later, more or less completely, and more or less comfortably, by most people on most occasions.

A food is called easily digestible when it can easily be turned by the digestive tract into absorbable nutriment and does not overwork the digestive tract nor irritate it.

Most Easily Digested Foods. To treat the digestive tract especially kindly, the following foods may be used. They will usually not overwork it nor irritate it.

Milk or malted milk; butter; cream; olive oil.

Eggs, soft-cooked.

Cereals.

Soup: bouillon, cream soup, oyster stew, chowder.

Meat: any tender or well-cooked meat except pork (cooked by any method but frying; well chewed).

Fish: any white fish (cooked by any method but frying).

Bacon, broiled.

Oysters, cooked by any method but frying.

Vegetables, cooked. Vegetables, raw: lettuce, celery (well chewed).

Macaroni and spaghetti, boiled or with cream sauce.

Bread, day-old or crisp toast. Crackers.

Fruit, stewed or canned.

Fruit juice, fresh or canned.

Puddings: custard, tapioca, jello, rice, junket.

Ice cream, plain.

Cake, plain (e.g., sponge, angel).

Cheese, cream.

What Foods Are Common Offenders? For many people the following foods are not easily digestible.

Fried Foods. Frying is a method of cooking that requires skill, for the fat must be hot but not too hot, or the food will be somewhat

irritating to the digestive tract. It is not desirable to eat fried foods unless sure of the cook's culinary knowledge and aptitude.

"RICH" FOODS. This term is applied to foods that contain a high percentage of fat, especially in intimate combination with proteins or starches. Fat digests more slowly than protein or starches, but usually as completely. The presence of much fat in a meal may delay digestion of the whole meal, and in the meantime discomfort may occur.

Among "rich" foods that may cause trouble are: gravies from which the meat fat has not been removed and to which starches have been added for thickening; fatty meat, such as pork (except bacon), and fatty fish, such as salmon and mackerel; certain desserts in which fats, starches, and sugars are combined, as in pie, plum pudding, etc.

OVERDONE MEAT.

UNDERDONE MEAT. Unless the meat is naturally tender, underdone meat may cause trouble. Usually meat requires cooking in order to soften its fibers enough to make it easily digestible.

CHEESE. Cheese (except cottage cheese), if taken in large quantities at a time, may disturb digestion. When cooked, cheese is less digestible if ropy and leathery.

DRIED LEGUMES (BEANS AND PEAS). Their cellulose covering seems particularly likely to ferment and cause gas when the legumes are baked with fat.

NUTS. Unless well chewed or finely ground, as in peanut butter, nuts may be troublesome.

UNDERDONE STARCHY FOODS. Underdone griddle cakes, muffins, and bread, for example, may be indigestible. Further changes take place in starches after they are cooked, which makes day-old bread more digestible than fresh.

UNRIPE FRUITS. Raw fruit, not well chewed, or unripe fruit may disturb the digestion.

RAW VEGETABLES. Unless young, tender, and fresh, and well chewed, raw vegetables are not easily digestible. (Even when cooked some of the vegetables with coarse cellulose—such as cabbage, turnip, and onion—need much chewing to make them digestible.)

HIGHLY SEASONED OR SPICED FOODS. The food may digest satisfactorily but may irritate the mucous membrane.

VERY SOUR FOOD. Pickles, for example, may be irritating.

VERY SWEET FOOD. Concentrated sugars frequently cause gastric irritation.

Faulty Combinations of Foods. Of one thing the average person is sure—that certain foods have a "poisonous" effect if eaten together or in the same meal. Unfortunately, superstition rather than science is utilized as a guide against harmful combinations. Superstition says, for example, that milk and acid fruit should not be taken together. Science says this is entirely harmless. To be sure, acid curdles milk, but milk must be curdled before it is digested; in fact, that is one of the functions of hydrochloric acid in the stomach secretion. Other superstitions too numerous to mention, are similarly unfounded.

There are, however, truly faulty combinations of foods. A faulty combination consists almost entirely of two or more foods each of which somewhat taxes digestion and which together may tax it beyond its tolerance. A meal of fried pork chops and gravy, fried potatoes, fresh biscuits, and pie; or of baked beans and pork, brown bread, and doughnuts—these are examples of the way foods should not be combined.

Food Idiosyncrasies. This term implies special difficulty in digesting a given food, a food that most people can digest without difficulty. The explanation may be some allergic reaction, but sometimes the cause is psychic.

Many people are afraid of a food they think has once upset them and refuse the food in the future without further trial. The disturbance may have been due to some other factor rather than to the food in question, and it may be worth while to try it again. This is especially true of foods that are in common use. To be unnecessarily finicky about the diet has both nutritional and social disadvantages.

Cooking to Improve Digestibility. Many foods are cooked for the following reasons: (1) to make them more palatable (e.g., meat); (2) to make them more digestible (e.g., starch); (3) to make them less irritant (e.g., cellulose); (4) to render them free from parasites and bacteria.

Cooking may not, however, serve any of these purposes unless it is done skilfully. Cooking is an art, and one which everyone should be required to learn before attempting to practice it. Undoubtedly, future generations will consider licensing a person who is to cook as important as licensing one who is to drive.

Are Preserved Foods Nutritious? Food that is properly preserved by canning or cold storage differs not at all in digestibility from the same food in a fresh state. Food preserved by other methods (e.g., pickling, salting, smoking, or drying) may thereby be rendered less readily digestible but usually not seriously so.

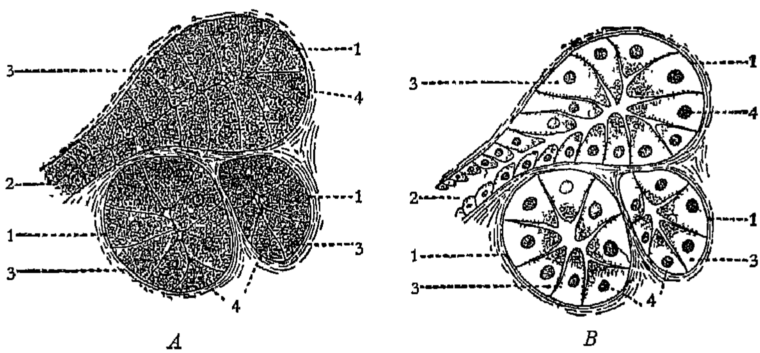
Certain foods may be dehydrated (i.e., have all their moisture removed) without change of nutritive value or taste. This is true of milk, eggs, and nearly all vegetables and fruit. Dehydrated foods have proved of great value in feeding armies, since they do not spoil while dry. To a limited extent they are beginning to be available to the civilian population.

Frozen or frosted foods are as nutritious as fresh foods. They spoil quickly after thawing, however, and should be cooked or eaten at once.

Why Must Foods Be Chewed? Mechanically, chewing (mastication) serves to subdivide food so that digestive juices may reach all parts of it. Also it serves to prevent possible irritation of the mucous lining of the stomach by large chunks of food. Finally, the motions of chewing serve to stimulate the flow of saliva and, thereby, of other digestive juices.

Chemically, chewing serves to start the digestive process through the action of saliva on starches, partly converting them to sugar. If not thus converted, starches may remain undigested until they reach the small intestine. Also, protein and fat, if not thus separated from starches in the mouth, will not receive proper digestion in the stomach and must await digestion in the small intestine. The effect of too little chewing is to place an undue burden on the small intestine which may rebel. This often occurs in those who lack molar teeth or who have the habit of bolting their food.

Should Medicines Be Taken to Aid Digestion? One of the most popular forms of self-medication is the taking of alkalis to relieve indigestion. Whereas alkalis (such as sodium bicarbonate or the popular pills for



(*A*) The parotid gland at rest. (1) *Acinus* (2) Duct. (3) *Acinous cells filled* with granules. (4) Nuclei almost concealed. (Semi-diagrammatic.) (*B*) Parotid gland after prolonged activity. (1) Acinus. (2) Duct. (3) Acinous cells almost free of granules. (4) Nuclei clear and well defined. (Semi-diagrammatic.)

indigestion) do counteract acidity of the stomach, they should not be self-prescribed. They merely relieve the symptoms for a short time and may do harm in four ways. First, they may cause one to postpone receiving treatment or changing habits so as to prevent or really cure the indigestion. Second, alkalis tend to cause the stomach to secrete still more acid to compensate for that which is neutralized, thereby causing symptoms to appear again very promptly. Third, alkalis taken steadily may unduly increase the alkalinity of the blood, producing alkalosis. Fourth, alkalis in the stomach destroy certain vitamins.

Alkalis are not poisonous in the sense that many of the self-prescribed medicines are, but in these four ways they may be as dangerous to take regularly.

Elimination

The Composition of Intestinal Waste. The intestinal waste consists of remnants of food which either could not be digested or were not digested, remnants of bile and digestive juices, a small amount of iron and calcium, a varying amount of water, and many bacteria (one-fifth or more by weight), the normal inhabitants of the large intestine.

On an average diet, the main bulk of the feces is cellulose from vegetables, grains, and fruit. Ordinarily there should be no undigested food—whatever is digestible should digest. Nevertheless, particles of food often do pass through the whole tract practically in their original condition.

Causes of Evacuation. Motion of the muscle fibers of the alimentary tract (peristalsis) causes food to move onward throughout its length. The rate becomes progressively slower, until finally in the colon this motion is very slow, the material in it being moved along chiefly by the oncoming material from the small intestine.

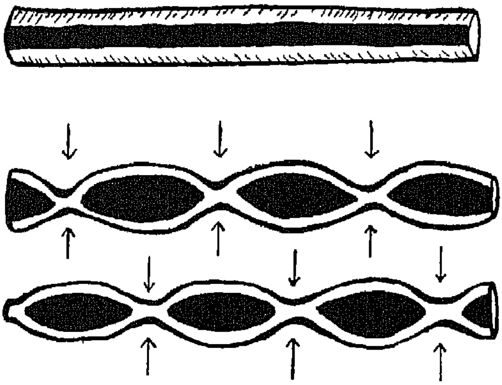
After a semisolid cylindroid of fecal material has formed in the terminal part of the colon, the defecation reflex is aroused, and this portion of the contents of the colon may be voluntarily discharged. This reflex may, however, be voluntarily inhibited. Under ordinary conditions the reflex is excited after taking food and is responded to once a day, with the passage of a cylindroid approximately 6 inches in length and 1 inch in diameter.

Conditions throughout the intestinal tract may make peristalsis more active than usual or less so. In either case, the character of the intestinal contents may be changed and the rate at which it is evacuated altered.

Also, many conditions affecting the health and many qualities of food may influence intestinal elimination. The two main disorders will be discussed under the headings diarrhea and constipation.

Diarrhea. This term means a flow of intestinal waste. The feces are fluid or semifluid because the rate of peristalsis has been too rapid for the usual absorption of water from the colon to take place. Evacuation occurs more frequently, usually with crampy pain in the colon, called colic.

Diarrhea usually is due to one of the following causes: (1) food that is chemically or mechanically irritating, as, for example, injudicious com-



The upper figure shows the intestine at rest. While digesting food its muscle fibers contract, first at one spot and then at another, compressing the mass of food as indicated. Still other sorts of motion take place also.

binations of rich foods, food that reaches the intestine in undigested particles, or unripe fruit, etc; (2) bacteria in food, causing intestinal infection such as dysentery, paratyphoid fever, typhoid fever, etc.; (3) excitation of the nervous system, with overstimulation of peristalsis; (4) chemicals that may act as irritants or as direct stimulants of peristalsis, of which the most common sort are cathartics. Some of these causes are capable of producing either diarrhea or constipation, or an alternation from one to the other.

In some circumstances, violent intestinal contractions may be physiologically necessary in order to expel an irritant, but if continued such overactivity of the intestines may cause fatigue of the intestinal musculature, interfere with due absorption of food, abstract too much water

from the intestines and the system as a whole, and, most important of all, change the chemistry of the body adversely by causing undue loss of mineral salts. Furthermore, the cause of diarrhea may be an ailment or a habit that needs correction. Therefore, habitual or recurring attacks of diarrhea, or even a single attack of any severity, should be investigated.

Constipation. This term may imply infrequency of evacuation; a change in the character of the stool, usually with drier consistency; reduced amount of stool; or difficulty in passage. Often it includes all of these variations from the normal. All are due to delayed progress through the intestines, most commonly in the terminal portion of the colon. Such delay is called *stasis* (standstill). Usually it is relative rather than absolute. The causes of delay lie either in the character of the food or in conditions of the digestive tract as determined by numerous causes.

As would be supposed, constipation often is due to weak peristaltic motion, in which case the muscle fibers in the intestinal wall may actually be weak or may be strong enough but not sufficiently stimulated to activity. When the bowel musculature lacks tone and acts sluggishly it is said to be atonic. Often the musculature throughout the body is in a similar atonic state. Atonic constipation is common in those whose health is under par. It appears to be particularly common in those who are generally malnourished, although not necessarily thin, and who lead a sedentary life.

A second type of constipation is due to irregular peristaltic motion, with at times strong muscular contractions steadily maintained in one area or another. Such contractions, called spasm, effectively check onward motion as long as they persist. The colon above the spastic area is likely to relax and balloon with gas or become overfilled with oncoming fecal material. Also, motion in the opposite direction (reverse peristalsis) may occur. Eventually a spasm relaxes, but others may occur in another area. This type of constipation is called spastic.

Is Constipation Harmful? Delay in the intestinal tract may give rise to symptoms or it may not. If symptoms occur they are likely to include a feeling of distention and local discomfort, with perhaps headache and a feeling of inertia. It appears that a mild degree of reverse peristalsis may be responsible for some of these symptoms. As for absorption of toxins from the colon, there is some reason for believing that that may take place if the membrane has become unhealthy as a result of long constipation or other causes.

Local reasons for preventing overloading of the colon involve the effect of pressure on neighboring structures. A large fecal mass may press upon the veins of the anus, giving hemorrhoids or "piles." Constipation and the resulting straining at stool often are the causes of this common ailment.

A mass of retained fecal material also may press upon veins leading to the legs and contribute to the formation of varicose veins. In some cases harmful pressure may be exerted upon the veins of the reproductive organs, causing congestion in them. Certain cases of menstrual pain may be definitely related to constipation.

Bacteria in the colon usually are not harmful, but if they migrate to the appendix, the gallbladder, or the pancreas they may cause more harm in these locations than in their normal habitat. Some authorities believe, however, that migration is more likely to occur when the stools are watery than when they are overdry.

Perhaps the fear of constipation is more seriously harmful than the ailment itself since it leads to the mistaken idea that if constipated one is ill and must take cathartics, the harmful effects of which are mentioned below.

Good Bowel Habits. Four points are of importance in connection with the process of evacuation. First, regularity in respect to time of bowel movement should be maintained. The defecation reflex is aroused as a result of the motion that occurs in the stomach after meals, causing peristaltic waves that extend as far as the colon. Evacuation occurs more readily after meals, especially after the first meal of the day. It is recommended that a morning habit be established but that the impulse be heeded, if possible, whenever it occurs.

Second, plenty of time must be allowed for the process of evacuation, usually as much as five minutes or more. Normal evacuation is seldom as rapid as that produced by cathartics, most of which cause urgency.

Third, voluntary attention must be given the matter or the habit of keeping the sphincter closed will persist at times when it should be relaxed. Attention should not be engaged otherwise, as by reading while evacuating.

Fourth, the position of the body should be such as to lend mechanical aid to evacuation—that is, the knees should be at least as high as the hips. If the toilet seat is more than 15 inches from the floor, a footstool may be used to raise the knees.

Factors Affecting Bowel Action

Diet. A diet that meets nutritional and digestive needs is of major importance in regulating the bowels. When constipation or a tendency to it exists, the chief cause may be that the diet is not well balanced or nutritive and therefore does not favor the physiologic functions, including elimination. Or the diet may not be easily digestible, and the undigested particles may cause difficulty throughout the tract. Or the total amount of food eaten may be so small in quantity that it takes a long time for the small residue to move onward. Or the residue may be small because almost all the food eaten was digested and absorbed.

Constipation is particularly likely to occur if the diet lacks thiamine. Without enough of this vitamin the tone of the intestines is reduced; stretching and ballooning of the intestines, with gas formation and constipation, is a common result.

Regular habits of eating also are an aid to regular daily evacuation. The digestive tract throughout functions best when it functions rhythmically.

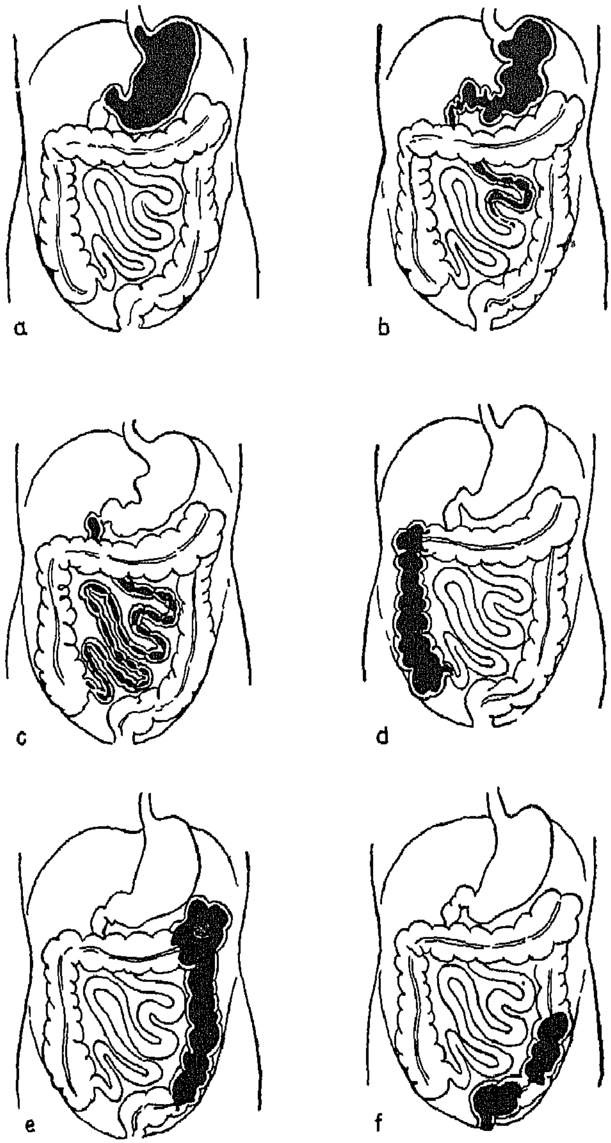
One substance in food, cellulose, has an important mechanical effect in aiding bowel action.

Cellulose. The large bowel must be provided with a reasonable amount of bulk to stimulate its musculature. It contracts more readily upon a mass of material that fills it to normal capacity. The natural source of bulk in the diet is fibrous material (cellulose) in vegetables, fruits, and cereal grains.

But cellulose may be irritating to the mucous membrane and arouse spasm of the musculature unless it has been softened by cooking or chewing or both. For many people, the coarser vegetables in the raw state, and also straight bran, prove too irritating. For some, such foods are helpful, but they should not be used except on medical advice. For the majority, the residue should be soft and smooth, not rough. Therefore, the term bulkage is preferable to the commonly used term roughage.

In many cases of constipation, a bland or smooth diet including the easily digestible foods mentioned on p. 94 and excluding those less easily digestible mentioned on p. 95 will be of assistance. Such a diet provides sufficient residue without causing irritation.

Water. A certain amount of water must be retained in the contents of the colon to provide bulk and a soft consistency. Whether enough water



The progress of a single meal through the alimentary tract. (a) Stomach filled at 6 p.m (b) Stomach partly empty at 9 p.m. (c) Stomach empty and small intestines filled at midnight. (d) Large intestine partly filled at 6 a.m. (e) Descending colon filled at noon. (f) Sigmoid and rectum filled at 6 p.m. (Note: variations in the rate of progress occur according to the character of the food and the activity of the tract.)

is retained depends partly upon the length of time the food residue remains in the colon and partly upon systemic need for water. If there is a shortage of water in the blood, owing to deficient intake of fluid, or to excessive sweating, or the like, the water in the intestinal contents may be rapidly absorbed.

Therefore, it is evident that the system must be kept supplied with enough water, or the excreta will inevitably be dried and usually will be delayed in evacuation. Often an additional glass or two of water a day makes a great difference in preventing a tendency to constipation. In some people, the effects seem to be particularly good if extra water is taken before breakfast. Hot fluids have a tendency to relax spasm and may, in some cases, be more effective than cold.

Exercise. Probably constipation is more common in those of sedentary habits than in any others. Often, the addition of half an hour of outdoor exercise a day is very effective in improving bowel habits.

Exercise accomplishes its good results in several ways. First, it improves the circulation of blood of the alimentary tract, which favors its healthy functioning. Second, it has a mechanical effect, gently agitating the abdominal viscera and massaging them one against the other. Third, through the effect upon the general health, the musculature as a whole may be improved and with it the intestinal musculature. Fourth, also through affecting general health, exercise of the right amount may tend to normalize the nerve impulses that govern peristalsis.

Posture. The posture of the body may be such as to cramp the lower chest and limit the motion of the diaphragm, thereby affecting local and general circulation. Also, it is likely to involve stretching and relaxation of abdominal muscles, with unfavorable effects upon the position of the viscera. It appears that poor sitting posture, in which the body slumps forward at the waistline, may be partly responsible for the constipation that occurs so often in the sedentary.

Garments that are unduly constricting about the waist may exert undue pressure upon abdominal organs. A well-fitted girdle, not too tight and not extending above the waist, may be an aid to good posture in those whose abdominal muscles are weak. On the other hand, tight elastic bands or belts may hamper free action of the intestines.

"Nerves." Since nerve impulses govern both motion and secretion throughout the digestive tract, it is to be expected that any disturbance of nervous equilibrium would be reflected in gastrointestinal function. What is commonly known as "nervousness" is often the fundamental

cause of constipation. The spastic type of constipation is particularly likely to occur in those of "high strung," excitable, or intense disposition, with whom the tempo of life is too rapid. The necessary calm may often be gained by extra sleep. In some cases, however, a change to a diet that furnishes all nutritional needs solves the difficulty with "nerves" and with the disorders resulting therefrom. Of course, it is true also that the emotionally unstable usually require better mental hygiene.

Why Are Cathartics Harmful? There is probably no habit of greater antiquity nor one more firmly established in the human race than that of taking cathartics. In the present century physicians have made careful studies of the effects of drugs that cause bowel movements and have become convinced that they often do harm in one way or another. While they are necessary in some conditions, they should not be used routinely, nor even occasionally, except on the advice of a physician.

Probably most of those who take cathartics actually do not need them. They are misled into thinking that they do because of the popular superstition that no day should pass without a bowel movement. A 2-day or 3-day interval is normal in some persons.

The habit of taking cathartics may be established after taking a single dose. That dose (which causes complete evacuation of the colon, leaving it nearly or quite empty) leaves nothing to be evacuated on the second day. On the second day, material will have arrived in the colon, but the fatigued or dried intestine will move it onward slowly, so that no evacuation occurs on that day. In apprehension, the individual then resorts to another catharsis. Many people who are thoroughly convinced that the bowels would never move without a cathartic have never waited long enough to find out what the results would be if the colon were ever allowed to become properly filled.

Others are misled into thinking that they require cathartics because they have a faulty standard regarding the amount that should be evacuated daily. Gauged by the amount eliminated after taking a cathartic, which empties the entire colon, the normal stool seems insufficient.

Still others are misled by the local discomfort often felt for a few days after taking a cathartic. Although due to the disturbance caused by the cathartic, they interpret it as indicating that the colon again needs emptying.

It is usually safe to stop the cathartic habit abruptly. Those who do so usually find that the bowels move normally without medicine, especially

if, at the same time that cathartics are stopped, improved habits such as those mentioned are established.

Body Weight

For each person there is a weight that is, for that person, optimal It is not necessarily the same as the weight given in standard tables for his sex, age, and height. The tables represent averages of what persons actually do weigh. Among those weighed to obtain these averages were persons of stocky, medium, and slim builds. Obviously, the stocky will weigh more and the slim less than the average.

Three Types of Stature. Three definite types of stature prevail among human beings. They are: the long-lean, or longilineal, or leptosomic type; the short-stocky, or brevilineal, or round, or pyknic type; and the intermediate or normilineal type. To borrow terms from the era of the horse, they may be called the race horse, the dray horse, and the carriage horse types. Uncle Sam, as he is portrayed by the cartoonist, is of the long-lean type, and John Bull of the short-stocky type. Individuals of any of these types may be short, tall, or medium in height; it is a matter of skeletal and muscular proportions, whatever the height.

The different types differ in respects other than stature. The intestinal tract, for example, is shorter in the longilineal type and longer in the brevilineal, the former corresponding to the carnivorous animals and the latter to the herbivorous. Also the rate of metabolism tends to be higher in the slim type and lower in the stocky. It is thought that the types tend to differ in temperament (the stocky being the more cheerful and out-going); in susceptibility to a different variety of diseases (the stocky frequently having gallbladder disease, for example, and the slim more often having gastric ulcer); and in longevity (the long-lean type being the longer lived, other things being equal).

Causes of Departures from Normal Weight. When an individual's weight is greater or less than his optimal weight, it is because of excess fat or excess fluid in the tissues—usually the former.

Excess fat is deposited when more calories of food are assimilated than are oxidized. Too little fat is deposited under opposite conditions—fewer calories assimilated than oxidized. When weight is stationary, the balance is even; but when it is changing, there is a disparity one way or the other between quantity of food assimilated and quantity oxidized for energy.

The stocky are especially likely to become fat, because of their longer

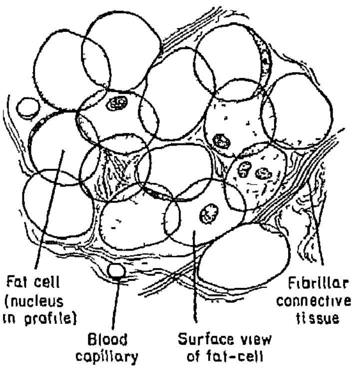
Table 12

HEIGHT-WEIGHT-AGE AVERAGES*

Height		Age 16		Age 17		Age 18		Age 19		Age 20		Age 21		Age 22		Age 23		Age 24		Age 25–29		Age 30–34		Age 35–39		Age 40–44	
Feet	*Inches*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*
4	10		*92*		*94*		*96*		*98*		*102*		*105*		*107*		*109*		*111*		*113*		*116*		*119*		*123*
4	11		*95*		*97*		*100*		*103*		*106*		*108*		*110*		*111*		*113*		*115*		*118*		*121*		*125*
5		101	*102*	103	*104*	105	*106*	107	*109*	110	*111*	112	*112*	114	*113*	116	*114*	118	*115*	122	*117*	126	*120*	128	*123*	131	*127*
5	1	106	*108*	108	*109*	110	*111*	112	*113*	115	*115*	117	*116*	119	*117*	121	*118*	123	*119*	124	*120*	127	*122*	130	*125*	133	*129*
5	2	111	*113*	113	*114*	116	*115*	117	*116*	120	*117*	121	*118*	122	*119*	123	*120*	124	*121*	126	*122*	130	*124*	132	*127*	135	*132*
5	3	115	*117*	117	*118*	119	*119*	121	*120*	124	*121*	125	*121*	126	*122*	127	*123*	128	*124*	129	*125*	133	*127*	135	*130*	138	*135*
5	4	119	*120*	120	*121*	122	*122*	124	*123*	127	*124*	128	*125*	129	*126*	130	*127*	131	*128*	133	*129*	136	*131*	138	*134*	140	*138*
5	5	124	*123*	125	*124*	126	*125*	128	*126*	130	*127*	131	*128*	132	*129*	133	*130*	135	*131*	137	*132*	140	*134*	142	*138*	145	*142*
5	6	128	*126*	129	*127*	130	*128*	132	*129*	133	*130*	134	*131*	135	*132*	137	*133*	139	*134*	141	*135*	144	*138*	146	*142*	149	*146*
5	7	133	*128*	134	*129*	135	*130*	136	*131*	137	*133*	138	*134*	140	*135*	141	*136*	143	*138*	145	*139*	148	*142*	150	*146*	153	*150*
5	8	137	*132*	138	*133*	139	*134*	140	*135*	141	*136*	142	*137*	144	*138*	146	*139*	147	*141*	149	*143*	152	*146*	155	*150*	158	*154*
5	9	141	*135*	142	*136*	143	*137*	144	*138*	145	*139*	147	*140*	148	*142*	150	*144*	151	*146*	153	*147*	156	*150*	160	*154*	163	*158*
5	10	145		146		147		148		149		151		153		155		156		157		161		165		168	
5	11	150		151	..	152		153		154		156		158		160		161		162		166		170		174	
6		155		156		157		158		160		162		164		165		166		167		172		176		180	

intestinal tract and thereby their greater amount of absorption, and because of their tendency to have a lower rate of metabolism. For the slim, the probabilities are the reverse.

The Dangers of Underweight. Thinness may represent malnutrition, in itself a serious condition; some sort of illness which prevents due assimilation of nutriment; excessive activity; or too rapid a rate of metabolism. It is possible, however, to be in excellent health and to have excellent habits and yet to remain thin (presumably because of a special type of metabolism).



Fat cells in adipose tissue.

Up to 35 years of age, it appears safer, according to reports of insurance companies, to be of at least normal weight or even a few pounds above. The danger of being too thin is not so much from thinness itself but from the abnormal conditions that so often cause it. Thinness is somewhat unsafe, even though not due to sickness. A due amount of fat in the tissues is of value as "emergency rations," to be drawn upon at such times as when illness prevents sufficient intake of food. Also, it acts as insulation against the cold and has several other physiologic advantages.

How May Weight Be Gained? The thin, especially the malnourished, usually can gain weight by a general improvement in diet. They usually need more food and perhaps different foods, with a more generous supply of minerals and vitamins. Milk is the best single food to add to the diet. It may be taken at meals or with a few whole wheat crackers as an extra meal.

While increasing the food intake, the thin may reduce their activities if they have been overactive, but some of the thin who have been leading quiet lives gain more by increasing their exercise a little, the explanation being that exercise may improve appetite, digestion, and circulation to such an extent that they can eat and assimilate more.

Those who remain too thin on an optimal diet should make sure that they are not ill or that habits other than dietary ones need correction.

The Dangers of Overweight. After the age of 35, expectation of life decreases one per cent for every pound overweight. Even before that

age, obesity is a danger. If the weight increases to 25 per cent above normal for the individual, the condition is called obesity. The following are some of the hazards of obesity:

1. Diabetes is very much more prevalent in those who are overweight. The one preventive measure advocated for this disease is keeping the weight normal. Overweight is considered a contributing cause since it is usually due to overeating, and overeating may burden the pancreas by calling upon it for excessive digestive function. Whether or not there is an accompanying hereditary factor, those who succeed in keeping their weight normal seldom develop diabetes.

2. Overweight puts a strain upon many other of the vital organs—the heart, the kidneys, and the blood vessels, in particular. Death from circulatory disorders is two and one-half times as high in the overweight as in the normal. A part of the cause is undoubtedly the heavy coating of fat around the heart and the fat deposited between the fibers of the heart muscle. The work of the heart thus becomes harder at the same time that its ability becomes less.

3. Liver and gallbladder diseases are especially common in the overweight, partly as a result of the strain they undergo in caring for

(*Left*) Perfect figure of health. (*Center*) Before and (*right*) after reducing. (Courtesy, Richard Hudnut Co., Inc.)

large amounts of food and partly because fat is deposited in the liver cells.

4. The overweight are likely to suffer from joint troubles due to the mechanical difficulty in carrying their weight. One of the forms of arthritis occurs very largely in the obese and especially manifests itself in joints that are subjected to the strain of weight-bearing (the knees, the lower back, and the ankles).

5. Surgical operations often are risky in the obese, partly because of difficulty of access to the abdominal organs through a thick layer of fat in the abdominal wall and partly because of impaired heart action, deranged metabolic state, and other factors more often unfavorable than in those of normal weight.

6. The obese are particularly affected by high atmospheric temperatures. Since they do not lose heat readily through their blanket of fat, heat stroke and heat prostration occur in them more often than in those of normal weight.

7. The obese are susceptible to the dangers of physical overexertion. They are not in condition to undertake many of the ordinary activities of everyday life without hazard, nor to meet any special needs for extra exertion.

8. Not only do the obese suffer directly from the obesity itself but also indirectly from their inability to take a normal amount of exercise with profit. Although a greater amount of oxidation would help to reduce their weight, after they have once become fat the obese usually are barred from the activity that would help them—barred not only because of their size, but because of their cardiac and other weaknesses. Obviously, this constitutes a vicious circle.

9. Recent data seem to indicate that cancer occurs proportionately more often in the obese than in those of normal weight or less.

The danger of obesity should be considered as having begun in those who are not yet actually to be classed as obese, but who are slowly and steadily gaining weight. Young people in the 'teens, especially girls, are likely to weigh a few pounds more than they will in their twenties and need not, as a rule, be alarmed by this slight degree of overweight, provided it is not increasing from month to month. A tendency to gain, however, should always be taken as a warning.

How Weight May Be Lost. Provided the metabolism is normal, a person who decreases his intake of calories while keeping his habits of activity the same will necessarily lose weight. If the body uses energy

at the rate of 2400 calories per day, it must have 2400 calories of combustible material. But if only 1400 calories are taken daily as food, 1000 calories must be obtained from body fat. The body automatically consumes its own tissues—the fat first—whenever there is a shortage in intake.

Since fat yields 9 calories per gram, it is apparent that in the circumstances mentioned, 111 grams of body fat will be used daily. Since 463 grams equal a pound, nearly one-fourth of a pound of body fat will be consumed daily, or nearly 2 pounds per week.

Loss of weight at this rate inevitably occurs in one whose metabolism is normal, as soon as certain adjustments to decreased intake have been made. Usually it begins in two to six weeks, and continues as long as the diet is 1000 calories short. In general it is well not to lose weight at a more rapid rate; nor is it usually desirable to reduce the number of calories much below 1400, however small the energy needs may be.

Reducing Diets and Nutritional Needs. The diet must contain the same amount of protein, even when restricted. Fat may be limited to 50 grams per day, and carbohydrates to about 120 grams, as follows:

	Calories
100 grams protein (4 calories per gram)	= 400
50 grams fat (9 calories per gram)	= 450
135 grams carbohydrate (4 calories per gram)	= 540
Total	1390

A suitable diet for reducing, modeled after the 9-point diet on p. 87, would be as shown in Table 13.

Exercise and Losing Weight. As an aid to losing weight, oxidation may be increased by taking exercise, but it takes a great deal of exercise to lose even one pound per week. Walking fast for 7 hours would not use as many calories as are furnished by 5 caramels. Even sawing wood, or playing football for an hour, or tennis for an hour and a half, would scarcely balance the calories furnished by 2½ doughnuts or a 5-inch sector of mince pie. Denial of appetite is easier and more successful than exercise as a reducing measure. For those who are only a few pounds overweight and who take little exercise, an increase in the amount of daily exercise will help them to lose weight and will usually be good for their general health. But those who are already obese should not suddenly begin a heavy regimen of exercise without obtaining medical permission.

Table 13

REDUCING DIET

Food	*Calories*
Meat, one medium serving	150
Milk, 1 pint	340
Milk products (i.e., butter, 1 level tablespoonful, total on or in food)	100
Egg, 1	75
Whole grain cereal: As cereal, one serving, with some of the allotted milk and no sugar	90
As dark bread, 2 slices half an inch thick	150
Green leafy vegetables, 2 servings	60
Root vegetables (carrots, beets, etc.), 2 servings	100
Legumes omitted, replaced by a root vegetable, e.g., medium-sized potato	100
Fruit (e.g., 1 large orange)	80
Special addition for young people to ensure enough vitamin D; cod liver oil (1 teaspoonful)	35
Special addition for all persons to ensure enough iron; molasses, 2 tablespoonfuls	110
TOTAL	1390

Are Medicines Useful for Reducing? Physicians sometimes find it necessary to increase the metabolic rate if a test of basal metabolism shows it to be low. Since the thyroid gland is the main activator of metabolism, thyroid gland extract may be used for this purpose. It is, however, one of the most powerful drugs known to medical science, and the person taking it must be examined regularly while taking the drug. It is, of course, entirely unsuitable for self-medication.

The same is true of any and all forms of "patent" medicines promoted as weight reducers; if they do reduce the weight they are likely to reduce the health as well; and if they do *not*, they reduce the pocketbook. The popular "antifat" remedies are about equally distributed in these two classes—the dangerous and the futile.

5

Doing Work

Muscular Work

The term work is used here in a physiologic sense meaning expenditure of energy. Energy is made available for the muscles by the combining in them of glycogen and oxygen. They use their energy in contraction, becoming shorter and wider. Most of the skeletal muscles are attached to bones, and their contraction causes motion at joints. The body as a whole thus is able to carry on muscle work in the various activities of everyday life, occupational or otherwise; in exercise taken deliberately for muscle technic or for health; and in sports, which are muscle work done as play.

What Happens as Muscle Work Increases? Obviously, there must be an increase in the amount of combustion in muscles when a change is made from relative inactivity to activity and a proportionate increase at every stage while exertion increases. This increase is possible because the muscle can oxidize or burn lactic acid, derived from accumulated glycogen which in turn has been synthesized from glucose. The liver is the principal glycogen storage organ, and this glycogen is readily available to be used in muscular activity. Increased energy production requires increased glycogen and oxygen in muscles.

To transfer glycogen and oxygen to acting muscles as quickly as may be necessary, many changes take place in the body, especially in the system whose function is transfer (the circulatory system) and the system whose function is the intake of oxygen (the respiratory system). Some of the changes that make vigorous muscle work possible will be outlined.

Increase of Heart Output. In a well person during maximum effort the following changes occur.

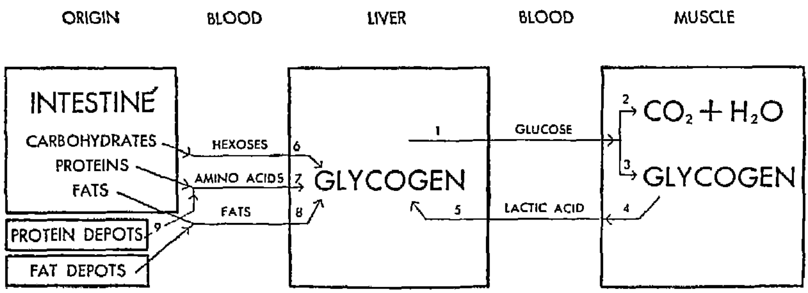
First, the volume of blood in circulation increases by discharge of blood from the spleen. The amount in circulation may increase from 6 liters to 7 liters. Second, the stroke volume of the heart increases. Instead of sending out 60 to 70 cubic centimeters of blood per beat, the heart may send out 200 cubic centimeters per beat. Third, the heart rate increases from 70 to 80 beats per minute to 150 or even more.

These factors combined increase the total output of the heart per minute from 3 or 4 liters of blood to 20 or 30.

Changes in Distribution During Exercise. The distribution of blood throughout the body changes during exercise. A relatively larger proportion is furnished to the organs that are most active—the skeletal muscles, the heart muscle, and the lungs. The skeletal muscles may receive 18 times the amount they receive during rest. At the same time, the organs not directly concerned in the activity receive less blood. At first the skin is deprived of some of its blood and looks pale, but, as exercise proceeds and the need for loss of heat increases, more blood goes to the skin and it becomes flushed.

As a result of increased heart action, the blood pressure within the arteries increases perhaps 50 per cent. In turn this increases the pressure in capillaries. Capillaries in working muscles being dilated, the blood flows through them more slowly, which allows extra time for the tissues to take up glycogen and oxygen and give off waste. The linear velocity through capillaries may be only half its resting rate. Also, capillaries not ordinarily in use become open, increasing the number perhaps from 200 per square millimeter to 2500.

The return of venous blood to the heart is increased because of the increased pressure of muscles against veins, the increased depth of breathing, and the rise of pressure in capillaries. In spite of the decreased linear velocity through capillaries, the onward progress of blood



The cycle of events to make energy available.

through an active muscle is more rapid than through an inactive one.

Increased Lung Action an Aid to Muscular Work. Obviously, during exercise the entire circulatory system becomes coördinated to one end —that of increasing the supply of oxygen to active muscles. Yet the facilities for carrying more oxygen would be futile if more oxygen were not available through increased lung action.

Breathing increases reflexly as a result of motion and emotion as soon as exercise begins. As exercise continues, breathing still further increases as a result of the excess of carbonic acid in the blood, a result of oxidation in muscles. The rate of breathing may increase from 18 breaths per minute to 30 or 40 or more. Also, depth of breathing increases; all the chest muscles as well as the diaphragm are used to the full, the mouth is opened for air intake, and the small muscles in the wings of the nose contract so as to open the nostrils as widely as possible. Lung ventilation may increase the intake of air from a resting rate of 5 to 8 liters per minute to 50 to 100 liters.

Since the blood during exertion comes to the lungs with as little as 3 to 7 cubic centimeters per cent of oxygen (instead of 14 when at rest) it is capable of taking up 12 to 16 cubic centimeters per cent (instead of 5).

What Is Oxygen Debt? All factors together, circulatory and respiratory, make possible an increase in the intake of oxygen from 0.25 liter per minute at rest to 4.0 liters (approximately a gallon) as a maximum.

But this manifold increase is not enough; one becomes "out of breath" during severe exercise and must breathe more rapidly for a varying amount of time after it. The explanation is that muscles can contract for a time without a sufficient current intake of oxygen, but lactic acid cannot be converted into glycogen until the due amount of oxygen has been taken in. In other words, oxygen is "owed" to the tissues until nearly all the glycogen has been reconverted, and this oxygen debt must be repaid immediately.

The maximum oxygen debt is about 8 liters. The average person cannot keep free of oxygen debt unless the oxygen requirement for the activity in which he is engaging is less than 2 liters per minute. At that level of oxygen consumption or below it, the body "pays as it goes," furnishing enough oxygen for the uses of the muscles and for the reconstruction and disposal of lactic acid.

The oxygen taken in during the period of recovery also serves to dispose of metabolic products other than lactic acid. In fact, the most

harmful are disposed of first. Some of the excess carbonic acid is utilized to re-form the carbonate of the blood, and the rest is largely blown off through the lungs.

Power Generated During Muscular Work. Much of the energy released during activity is released as heat rather than as muscle energy. The human body, when highly trained, turns out heat and work in about the same ratio as the best gas engine (i.e., 65 to 75 per cent heat and 25 to 35 per cent energy). The untrained person must do a great deal more internal chemical work in order to accomplish the same amount of work and has a proportionately large amount of heat to be dispelled. More often, the untrained person is unable to do as much work as the trained. But even the least trained muscles are more efficient than the simple steam engine in which the ratio is 95 per cent heat to 5 per cent work.

The maximum energy production in man is reached perhaps in the 100-yard swimming race, which utilizes energy at the rate of 12,000 calories per hour. Sprinting is very near to that level.

For sustained work, the maximum is very much lower—probably 600 calories per hour above the basal level is the maximum. Activities that may reach the maximum are long distance running, such as marathon races (or even dance marathons); mountain climbing of high peaks by expert climbers; channel or other long distance swimming; rowing races, which may go beyond this level near the finish; and wood-chopping in a forest. Others that may utilize nearly the maximum are wrestling and boxing.

Is Heavy Muscular Work Beneficial to Health? The terms hard work, strenuous or severe exercise, and heavy sports usually are taken to mean muscular exertion near the limits of human capacity. Such work can be done only by those whose capacity is near the maximum. Persons of unusual capacities (inherited or developed by training) are able to do heavy work without harm and in many ways with benefit to general health.

A better way to consider the severity of work is not in reference to the work itself, but in reference to the person doing it. What would for some persons be light work or moderate work would for others be very heavy; and vice versa.

The fitness of an individual for different degrees of muscular work can be determined by a physical examination to test the heart's ability to increase its work and by tests to determine how much oxygen debt

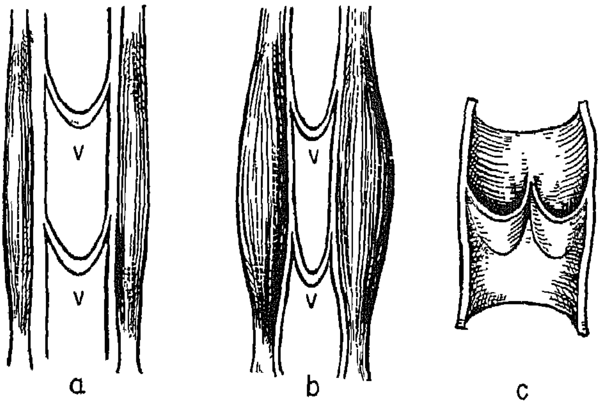


Diagram of a vein between two muscles. (a) Muscles relaxed. (b) Muscles contracted and pressing upon vein, valves (v) preventing back flow. (c) Vein open to show cup-like valves.

he incurs in a measured amount of exercise (e.g., running in place a given number of steps) and the time it takes for his breathing, pulse, and blood pressure to return to normal.

Even the layman can sometimes form an estimate of a person's fitness by his color. A markedly dusky or bluish color of lips and skin during and after exertion suggests a pronounced shortage of oxygen in the blood, which may mean that too large an oxygen debt has been incurred (i.e., that the work is too heavy).

When the reaction to exercise is not good, the difficulty may not be in the heart. The following defects may cause early breathlessness: (1) lack of mechanical training in the task in question, with a consequent expenditure of too much energy in doing it; (2) low vital capacity (amount of air that can be taken in and given out at a breath); (3) diminished efficiency of chest muscles, hampering lung expansion, as in the elderly; (4) anemia, in which the small number of red blood cells or their deficiency in iron limits the amount of oxygen that can be taken in; and (5) certain chemical conditions in the body which interfere with intake of oxygen.

In the case of each person, there is a point beyond which exertion would be impossible; below that, a point where exertion might be injurious; below that, a point where exertion gives the maximum benefit to health and more exertion would add nothing to general health and fitness—and below that a point where exertion is not even enough to maintain "average" health.

The majority find it practical to strike somewhere near the point of maximum benefit to health—below the possibility of injury by too much and above the possibility of injury by too little.

When suitable, muscle work benefits in two main ways: (1) it increases the power to do muscle work easily—an advantage in most careers and in most forms of recreation; (2) it keeps metabolism and circulation normally active—an advantage to every function of body and mind.

Exercises: FORMAL. Formal exercise is muscular activity taken primarily for the purpose of (1) using and training the muscles to strengthen them and to obtain skill in given acts; (2) for the general improvement of neuromuscular coordination and correction of motor awkwardness, and (3) for the various benefits to health such as accrue from any suitable exercise. Formal exercise includes "setting up" exercises done at home and gymnasium exercise done with or without apparatus.

In colleges, formal gymnasium exercise is used for all the purposes mentioned above. Acquiring skill and strength in the fundamental motions (standing, walking, sitting, running, jumping, climbing, vaulting, hanging, throwing, striking, and lifting) is a part of every normal person's education, in college if not before. Acquiring and maintaining physical endurance to a degree that aids work while in college and afterward also may be considered part of a college education and a national obligation.

Gymnasium exercises for postural benefit. (Courtesy, Sargent School.)

SPECIAL EXERCISES. Special exercises, as contrasted with general exercise, imply individual needs. They may be used to strengthen certain muscles that are weak (as muscles weakened by infantile paralysis, the heart muscle, the antigravity muscles controlling posture, the buttressing muscles that strengthen the foot, or the abdominal muscles that keep the abdomen flat). They are often needed for improvement of a physiologic function dependent upon muscular strength and control.

SPORTS. Since sports are play as well as muscular work, they are naturally popular, and for many persons they constitute the best form of exercise.

The element of competition makes for strenuous activity, however, and this is not an unmixed blessing for some. Although all colleges make an effort to see that team members are of nearly the same endurance and that teams are evenly matched, the incentive to play too hard and too long may cause some to overdo.

Unfortunately, pride prevents many a person from admitting an athletic achievement is beyond him. On the other hand, many a person holds back from taking part in team play for the very reason that he fears he will not be a credit to himself and the team.

It would be better if everyone passed for a sport by the medical adviser were to go into training, see what he can do, and not feel embarrassment if he does not at once have the requisite skill and endurance.

TRAINING FOR ATHLETICS. The concept of training is a familiar one with respect to heavy athletics; it should be equally familiar with respect to any increase of activity beyond a present level. For example, the desk worker who decides that he needs more exercise should plan a training period in embarking upon golf or tennis or swimming or bowling or even gardening.

The principle of training rests upon the fact that the body cannot change its entire mode of operation instantly. The heart will not, for example, increase its stroke volume from 60 cubic centimeters of blood to 200 the first time such an increase is demanded of it but only after its musculature has gradually gained in power.

The matter of gradual training is of particular importance in the case of those who are in any way handicapped either by the results of previous inactivity or by disease. For those who are no longer in their first youth, it is absolutely imperative that they increase their activity, if at all, gradually and watchfully. It would be preferable for those of

middle age to take no exercise at all rather than to increase their exercise to any extent without a due period of training. With some young individuals the same is true.

One of the important features in training is regularity. It is scarcely more feasible to take a week's exercise in one day than to take a week's food in one day. Some persons take little exercise during the entire year and go on an "exercise spree" during the two weeks of their summer vacation. Even if it does not harm them, the benefit can hardly be

Swimming is excellent exercise for muscle training. (Courtesy, Associated Press.)

expected to last during the year. As someone has said, one cannot get along on last year's exercise any better than on last year's bathing.

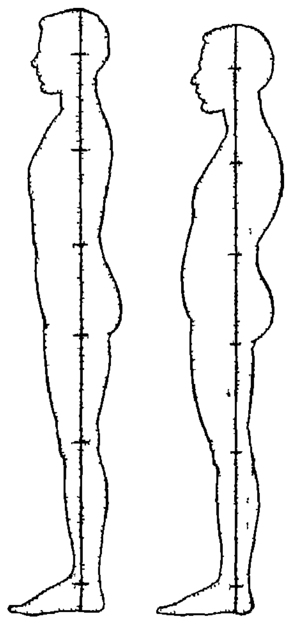
"Training down" after a season of great activity in sports is nearly as important as training up. Almost all physiologic adjustments are best made gradually. One of the dangers of dropping one's habits of exercise too completely and too suddenly is that a good appetite usually persists, and that eating habits may remain the same while combustion habits are greatly reduced. The former athlete often puts on weight and some of the fat may be deposited in and around the heart. Defective

heart action in such a person is sometimes wrongly attributed to exercise when it is really due to faulty methods of training down.

Mechanical Technics

Energy is being used constantly either to move the body or to hold it in stationary positions. All such acts are matters of mechanics and subject to its laws. For every muscular act the body performs, there is usually one way to obtain the best results with the minimum of waste motion. In other words, there is usually a correct technic in all acts—from striking the keys of a typewriter to pitching a baseball or walking a tightrope.

Training at the hands of experts usually is the method of developing correct technic, although there are some who are able to develop a skill or "knack" by trial and error. In two respects, (1) stance and carriage and (2) the use of the feet, it appears that the majority do not develop skill. This is unfortunate, for these are the fundamental mechanical acts and, in ways to be mentioned, affect bodily health.



Alignment of the body. (*Left*) Correct, and (*right*) incorrect. Note decrease in height in right figure.

Stance and Carriage

Skeletal Alignment. The skeleton cannot be lined up so that it will balance itself completely; as soon as muscular control is lost, as in unconsciousness, the body topples over. Nevertheless, it can be lined up so that gravity exerts a minimum of pull toward the earth, and the minimum of muscle power is needed to keep it upright. In the most favorable alignment the center of gravity of each segment of the body is directly above that below it. A plumb line dropped from the ear will pass through the center of the neck, shoulders, hips, and knees, and the plumb bob will be at the center of the ankle.

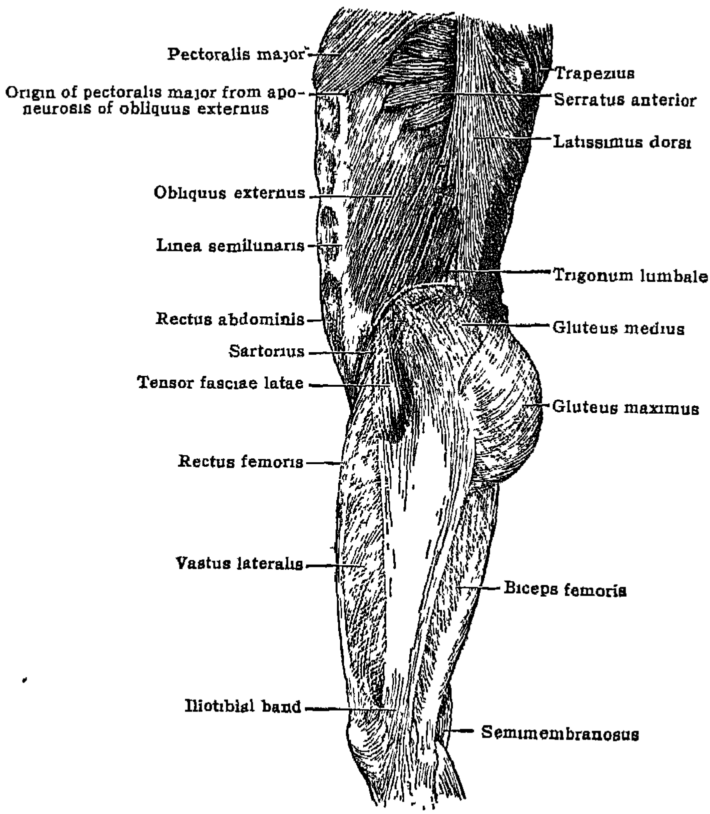
Muscular Alignment. The muscles which act to maintain posture may be classed with reference to the force of gravity as protagonists (favoring gravity) and antagonists (against gravity). They are arranged in op-

posing sets, both sets acting simultaneously to hold the body upright and one set relaxing while the other contracts when bending takes place.

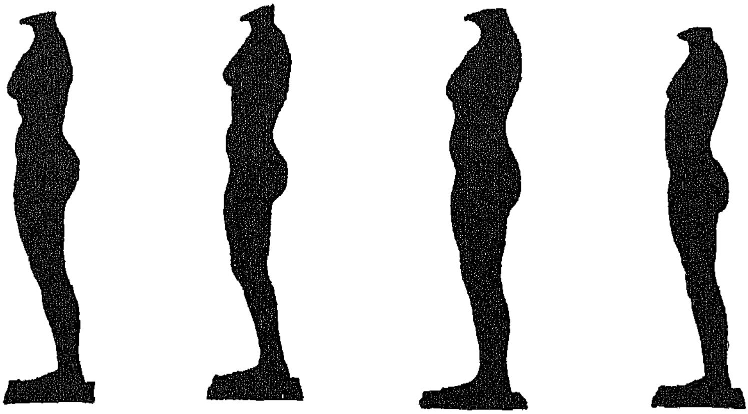
The chief antigravity muscles are the extensor muscles on the back of the neck and trunk, the muscles on the front abdominal wall, those on the front of the thigh, with tendons passing in front of the knee, and those on the back of the leg (calf) with tendons passing behind the ankle.

If any part of the body is held off-center, another part must be off-center to counterbalance it. The body can be kept from falling when its various parts are off-center but only at the expense of extra muscular effort. Engineers use the term eccentric loading; they know that in any structure they must either guard against it or provide extra support for it.

It is eccentric loading that is the important element in most types of poor posture and poor carriage in walking. The difficulty arises most commonly as a result of the fore-and-aft mobility of the spine.



Superficial musculature of abdomen and thigh.

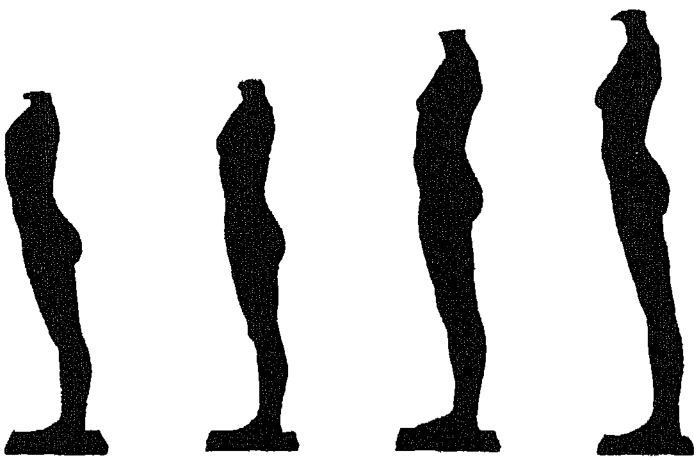


Exaggerated spinal curves.

Posture: Spinal Curves. At birth the spine is straight, but four slight fore-and-aft (anteroposterior) curves appear after a child begins to walk. They are an advantage in giving resilience in motion; walking would be uncomfortable if the spine did not "give" a little with every up-and-down motion.

The spinal curves are the cervical, forward at the neck; dorsal, backward in the upper spine, with the convexity greatest at the shoulder level; lumbar, forward at the waist; and sacral, backward at the hips.

Each spinal curve is very slight, and they alternate in their direction so that the spine as a whole is perpendicular. Bending can take place at



Faulty efforts to stand straight.

each of the many spinal joints so as to increase or decrease these curves as the body moves. But the joints are so constructed and the weight of the body so distributed that forward motion (flexion) is of wider range than backward (extension).

COMMONEST TYPES OF POOR POSTURE. By far the largest percentage of poor posture is the slouching type due to increase of one or more spinal curves, usually of all.

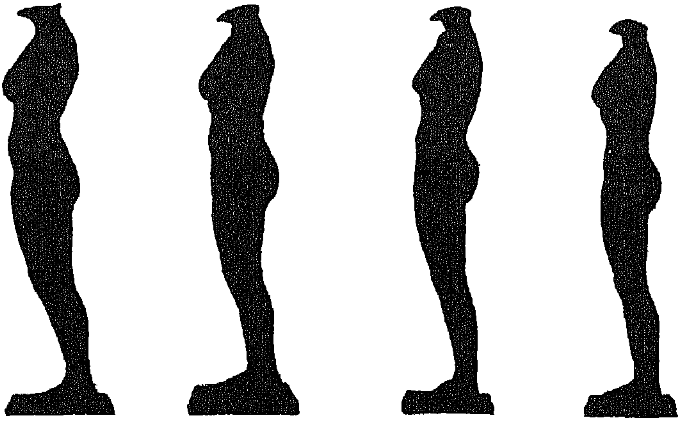
Once any normal spinal curve is increased, another curve is likely to increase to counterbalance the weight thrown off-center by the first increased curve. All four spinal curves are likely to increase, and further compensatory bending may be necessary at hips, knees, and ankles. "Sway-back" occurs typically with round shoulders, but frequently the whole back is a long curve from the waist to the neck, with a short sharp compensatory curve just below the waist.

CAUSE OF SLOUCHING. It is believed that the habit of sitting with the head forward and the chest low is the starting point of poor posture in many cases. The antigravity muscles have a tremendous pulling force to overcome, and the tendency of the body when weak is to yield to gravity. Such weakness may be present at times of malnutrition or illness. But often at the time poor posture is revealed in a physical examination, there is no lack of muscle strength but simply the bad habit of slumping.

Postural Effects: POSTURE AND JOINTS. Obviously, if a joint is constructed so as to move in given directions or within a limited range, it will be injured if forced to move in other directions or outside its normal range of motion. Wrong relationships of bones to each other, if continued, amounts to chronic sprain. When posture is poor, many joints are likely to be thus affected. Stretching or relaxation of the ligaments may cause joints to become "loose"; but if extra motion and friction occur in a joint it is likely to become inflamed, enlarged, and stiffened.

Any joint in the spine may become painful, but the joints of the lower back are especially likely to do so. Some of the pains called lumbago or sciatica are due to poor carriage. Also, the knees may give trouble as a result of eccentric loading of body weight. One type of rheumatism occurs especially in those whose posture has long been faulty. Although it does not appear in youth, the foundation for it often appears to be established then.

POSTURE AND ORGAN ACTIVITY. At its best, the upright position



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Improvement in posture after one year.

Improvement in posture after two years.

is none too favorable for organ activity. The organs, instead of being virtually on the same horizontal level as in quadrupeds, are on several different levels, some above and some below the level of the heart. Therefore, circulation to or from organs presents some difficulties (e.g., circulation must be against gravity in carrying blood to the brain and from the abdominal and pelvic organs).

Furthermore, because the organs within the trunk are in a vertical relationship to each other and to gravity, those above may in unfavorable circumstances press downward upon those below.

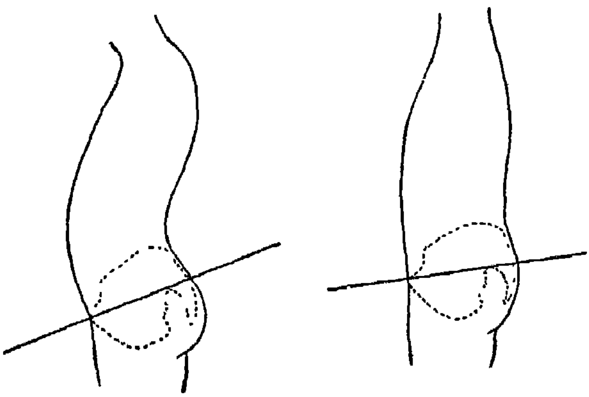
For these two reasons, any upright position is theoretically less satisfactory physiologically than a horizontal position; in times of stress (e.g., during shock, when all vital functions are depressed; during illness; and during great fatigue) the horizontal posture must be resumed.

Nevertheless, in everyday life, many potential difficulties associated with the upright position may be avoided and the body's functions be well performed, if the difficulties are understood and avoided by attention to correct carriage. The difficulties arising in connection with the organs of the chest, abdomen, and pelvis have been mentioned elsewhere.

Posture and the State of Mind. First, an erect carriage improves the appearance and becomes a legitimate source of pride. Second, it gives the impression of alertness, good health, and self-respect, all of which are a social and often an economic advantage.

Third, as a result of suggestion, an upright bearing may help one to be upright in other ways. A person who, after being perplexed and bewildered, straightens up as he makes his decision is manifesting in his body what his mind is doing. In trying to adjust psychologic difficulties it often helps if one assumes the posture that comes with problems settled and courage within.

Fourth, as a result of improved circulation and the improvement of physical function in many ways, disturbing states of mind may not arise so often and may be more readily overcome.



(*Left*) Diagram to show the angle of the pelvic bones and angle at the groin in poor posture, and (*right*) good posture.

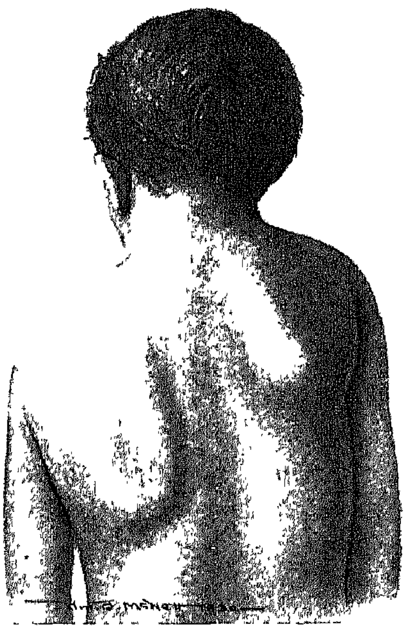
Correct Postures: Sitting. To sit correctly one should sit squarely on the chair with the lower spine against its back. Preferably, the chair should be one in which the back and the seat are at right angles or even a little less, in order to bring the thighs at a right angle with the body. While at rest the whole chair back should be utilized. When it is necessary to bend forward, bending should be done at the hips, decreasing the angle between spine and thighs, or at the joint between the head and the neck, or at both places. An important rule for sitting is "Do not buckle at the waistline," or, stated in positive terms, "Sit tall."

Walking. Again, the principle of stretching the spine to its full length is to be followed; the rule for walking is to "Walk tall." Nearly all the rules for standing are equally applicable in walking. Instead of the smooth, poised, easy gait that denotes skilful management of the body, a lurching, jerky, fatiguing gait is inevitable when the body is out of alignment.

Those who can stand well should be able to walk well, but the gait also depends upon the use of the feet and upon practice in the technic of walking.

SPINAL CURVATURE. There should be no lateral (side-to-side) curves of the spine. As viewed from the rear, the spine should be perfectly straight.

When lateral curves occur, they may be postural—that is, due to faulty habits of carriage. Or they may be due to inequality in the length



Scoliosis, or lateral curvature of the spine.

of the legs, which distorts the angle of the hips and thus the curves of the spine. Or they may be due to disease of the bones of the spine or the chest. From whatever cause, the presence of lateral curves is called scoliosis, commonly known as curvature of the spine.

Ten Important Rules for Posture. 1. STAND TALL. Stretch the spine to its full length, thereby reducing any spinal curves (fore-and-aft or side-to-side) to the minimum. This is a universal rule for correct posture, whatever the stature or the postural defect. It applies to all persons in all conditions at all times.

2. Raise the breast bone. As it rises, the spine in that region flattens.

It should be kept moderately high all the time, allowing for a little additional rise in breathing.

3. Balance the body on both feet in such a way that it will not list forward or backward at ankles, knees, or hips.

4. Push the upper back part of the head as far upward and backward as possible, without forcing the chin inward or upward or downward, but practically ignoring it.

5. Press the shoulders downward and slightly backward, so as to bring the shoulder blades flat against the back.

6. Allow the arms to hang freely, not pressing the elbows backward.

7. Widen the chest moderately from side to side, allowing for a little additional widening in breathing. Gauge the widening by the intercostal angle, the angle formed by the ribs just above the waist. It should be nearly a right angle.

8. Flatten the abdomen, exerting an inward and upward pull on the antigravity muscles of the abdominal wall. Do this not by drawing in the breath, but by the use of the muscles. It should be possible, especially in the young and slim, to make the abdomen nearly flat.

9. Tilt the hips to their normal angle, as shown on p. 126. Usually the hip bones must be brought to a more horizontal position, a maneuver that is not always easily accomplished at the first trials.

10. While holding the posture just described, see whether the body feels rigid. If it does, try to hold it in the same position while relaxing the muscles everywhere just enough to take away the rigidity. To obtain the unstrained "feel" of good posture it is helpful to think of one's self as suspended from above by the upper back part of the head.

The Foot

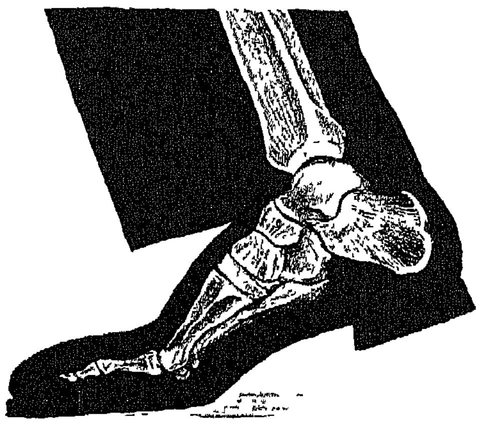
In the experience of many examiners of college freshmen, beginning weakness of the feet is second only to decay of the teeth. Among thousands of children 8 to 14 years of age, one physician found that 80 per cent of the girls and 65 per cent of the boys already showed signs of foot weakness.

Structure and Normal Appearance. The foot is built much the same as the hand. It comprises many bones firmly held together by ligaments and tendons. Between the heel and the ball of the foot, the bones form an arch. Body weight falls at the apex of this arch and is equally distributed to both ends of it. At the front, the weight is borne on the ends of the

five long bones of the foot, and part of it is distributed from there to the ends of the toes.

Although motion of the foot is produced partly by small muscles on its sole, it is produced chiefly by muscles in the front and calf of the leg, whose tendons run through the ankle and are attached to bones of the foot.

In standing, the central axis of the foot, ankle, and leg forms a straight line. The ankle, when viewed from the front or the rear, appears upright. The outer and inner prominences of the ankle are about equally prominent. The inner border of the sole from ball to heel is slightly

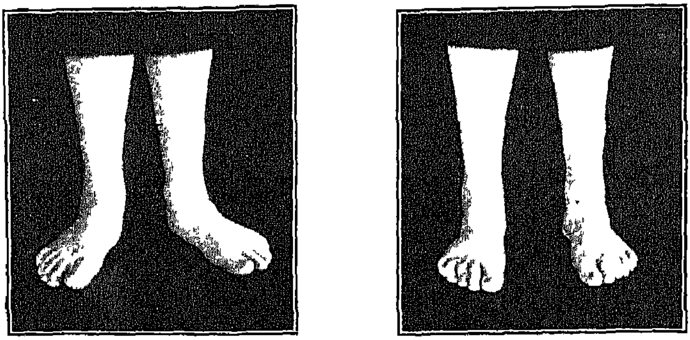


Bones of the ankle and foot.

raised from the floor. The foot remains approximately the same length and width when bearing weight as when at rest. The long bones of the foot lie close together, not fanning outward. The toes lie side by side, slightly curved toward the floor. The large toe is straight. Corns and calluses are seldom present.

Pronation. *The commonest abnormality of the foot is pronation,* or rolling the ankle inward. The inner prominence of the ankle is more prominent than the outer. The inner border of the sole approaches or even touches the surface beneath. The latter characteristic gives pronation its popular names "flatfoot" and "fallen arch."

EFFECTS. Mechanically, pronation places the foot at a disadvantage. The weight of the body falls on the apex of the arch, but the apex has moved inward, so that the whole weight-bearing tripod is on a slant. Body weight therefore is not properly balanced squarely over the bones



(*Left*) Pronated feet, front view. (*Right*) The same feet after training. (Girl 20 years old.)

that are calculated to bear it but falls too heavily upon the soft structures at the inner side of the foot.

It has been estimated that an individual weighing 150 pounds drives 178 tons of body weight upon his feet every mile he walks. In those who pronate, virtually none of this weight falls where it should. The result is that the foot becomes distorted at many of its joints, which "give" more than they should; ligaments and tendons become stretched, and often the joints become inflamed and painful.

The motor result of pronation is instability of the foot in standing and especially in motion. This is the condition that is usually present in those who have "weak ankles" that turn frequently and that do not permit of such sports as skating.

Secondarily, body mechanics as a whole may be disarranged as a result of disarrangement in the weight-bearing structures.

It is because of the unfortunate motor results that the feet are of such importance in armies. Napoleon said, "An army with sore feet is half defeated." The only remedies in former times were soothing external applications and massage. These were used even for the warriors of ancient Greece and Rome. Today we know that valuable as these measures are, they do not correct the underlying mechanical difficulty.

CAUSES. Pronation is due to lack of the buttressing effect of a tendon which passes down from a leg muscle to the ankle, behind the inner prominence of the ankle, and thence diagonally forward under the sole of the foot, to be attached to bones at the ball.

If this buttressing muscle is not properly used, the weight of the body falls on the inner edge of the weight-bearing tripod. And when the weight falls ever so little toward the inner side of the foot, this tendon

becomes stretched, it is less effective as a buttress, and still greater pronation occurs—a vicious circle.

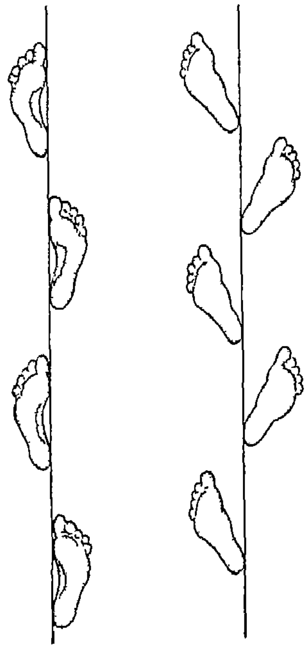
It is thought that the first abnormality in weight-bearing may occur at a time when the leg muscles are weak through illness or undernutrition at any time in life from infancy onward. Unquestionably, poorly designed shoes, forcing the ankle to roll inward, may be a cause.

Eversion. Eversion, or "toeing out" increases the distance between the internal prominence of the ankle and the attachment of the buttress tendon. As a result, the tendon has proportionately less mechanical power than when the toes are pointed straight ahead.

Toeing out may be either a cause or a result of pronation. If pronation begins first, toeing out is likely to follow—the individual reflexly seeking to widen the base upon which his weight is carried. The obese and the muscularly flabby usually do this.

Those who pronate usually both toe out and knee in. Knock-knees commonly are a mechanical compensation for eversion.

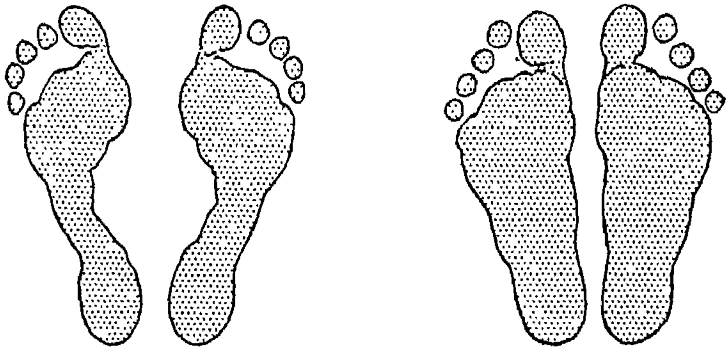
Use of Toes. When the toes are used in a gripping motion, it adds a great deal to the mechanical strength of the foot in standing, walking, and all propulsive motions. The large toe should furnish more than 50 per cent of the total foot power in propulsion of the body.



(*Left*) Footprints as they should appear and (*right*) as they should not appear.

Also, the use of the toes relieves the bones at the ball of the foot of some of the body weight. Across the ball of the foot a second arch, the anterior arch, appears when toe-gripping occurs. If the toes are not used, the heads of all the long bones strike hard upon the surface beneath at each step because none of the body weight is distributed beyond them to the toes. As a result, pain ultimately occurs in the ball of the foot, and calluses usually appear beneath it. (Sometimes sole calluses are not due to mechanical causes but to the fungi of athlete's foot.)

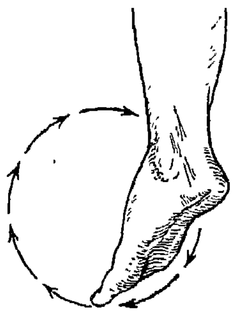
How May the Feet Be Strengthened? Mechanical power in the feet may be increased in most persons, and fatigue be decreased in standing,



(*Left*) Type of tracing described as normal, with outer border touching ground. (*Right*) Tracing of flatfoot.

walking and other foot work, by overcoming pronation, usually a simple matter.

To do this, the correct position of the foot may be practiced as follows: Stand with the feet parallel about 4 inches apart; hold heels and balls firmly on the floor; grip with the toes; then make an effort to throw the weight over to the *outer* side of the foot. (While the heels and balls are on the floor, the weight cannot fall on the outer side of the foot, but the effort to cause it to do so results in its falling over the apex of the weight-bearing tripod in the center of the foot, which is where it belongs.)



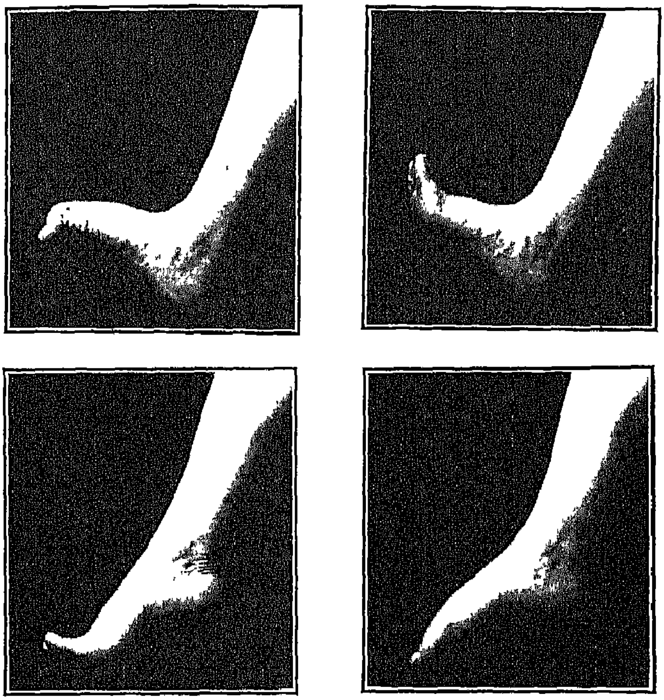
Illustrating the foot-circling exercise.

Another exercise that is of value in strengthening the buttress muscle is stroking the shin of one leg with the sole of the other foot.

To make correct use of the feet habitual, it is necessary to remember to do the following in standing and in walking:

1. Point the patella (kneecap) straight forward.
2. Point the foot straight forward.
3. Hold the ankle upright, as described.
4. Grip with the toes.

Relation of Shoes to Use of the Feet. Shoes may make correct use of the feet possible or impossible. Even shoes of the best design do not of themselves ensure that the feet inside them will be used well; they simply make it easier. But shoes of poor design can practically force feet to be used wrongly.



Foot exercises. (*Top, left*) Foot up. (*Top, right*) Toes up. (*Bottom, left*) Foot down. (*Bottom, right*) Toes down.

In buying shoes one should ask the following questions (it also would be advisable to ask them regarding shoes already in use and to give away those not meeting personal requirements).

1. Are they the right length? Do they permit the large toe to lie straight, with no pressure on its tip either in standing or walking? (A large proportion of draftees were wearing shoes that were too short and as a result had everted large toes, with enlargement and inflammation of the toe-foot joint, up to the point of bunion; ingrown nails; and decreased foot power and marching ability.) The foot should be measured while weight is being borne on it, for the weak foot may lengthen a half-inch under body weight. Incidentally, short stockings can be nearly as deforming as short shoes.

2. Are they the right width? Not only corns, but also general hampering of motion, result from too narrow shoes. Too wide shoes are equally objectionable.

3. Are they broad enough at the front? All the toes should have room to lie straight forward and to be used in gripping.

Foot exercise: gripping with the toes.

Foot exercise: moving the large toe inward, away from the other toes.

4. Do they fit closely at the heel but not too closely? They should neither bind nor slip in walking.

5. Does the upper edge of the shoe lie close to the foot without gaping? Gaping usually indicates that the last of the shoes does not correspond to the shape of the foot or that the shoe is the wrong size.

6. Does the shoe fasten firmly around the waist of the foot? (I.e., does it hold the long bones in their normal close relationship to each other, rather than let them spread apart?) For active use of the feet, except possibly for dancing, laced or strapped shoes are essential.

7. Is the heel of suitable height? The use to which the shoe is to be put determines suitability of heel height. For active pursuits, the foot and the entire body may be used to greater mechanical advantage if the heel is not raised more than 1 to 1½ inches. Flat heels are not harmful to the normal foot, but flat-heeled shoes, plus pronation and eversion, give a particularly awkward and inefficient gait and may make pronation worse. High-heeled shoes are suitable only when little footwork is to be done or for dancing (when the foot is used with the heel off the floor in any case). High-heeled shoes for occasional use are not as harmful to the mechanically strong foot as to the already weak one.

8. Does the shoe permit of carrying the ankle upright? Many shoes are designed for those who already pronate and will gape on the inner side when the weight is carried where it belongs. This is the final test of a shoe; if the exercise on p. 133 cannot be done without distorting the shape of the shoe, it is not a suitable shoe and, if worn, will hamper correct use of the feet.

Mental Work

The amount of brain work a person can do and the quality of it depend upon one factor that cannot be changed and upon many factors that can be changed. The immutable factor is, of course, the inherited number and quality of brain cells. There are limits beyond which a person cannot go in mental achievement, but these limits are probably never reached.

The variable factors are physiologic, emotional, and environmental conditions and, of course, training in the use of the brain—a matter of education.

Health and Brain Power. The brain being part of a biologic unit, the body, the capacity of the brain to work well depends to a large extent upon how well the rest of the body works. It is generally agreed that to obtain the best service from one's cerebral neurons, health is a decided advantage. That has probably been the case, for example, with 150 of the most learned men of the country, members of the National Academy of Sciences. They were examined by their fellow member Hrdlička, anthropologist of the Smithsonian Institution, who found them "living proof that the most brilliant brains are usually found in the huskiest bodies." The same probably was true also of a large series of graduate students in one of the colleges; 99 per cent of those with an I.Q. over 140 (the genius class) were in good health.

A multitude of physical factors are of significance in determining whether an individual is able to make good use of good brains. Two are of special importance in everyday life.

IMPORTANCE OF GOOD CEREBRAL CIRCULATION. Hrdlička has suggested that man has the inherent brain capacity to think from ten to a hundred times more effectively than he does now, and that "with a rich blood supply and no waste matter cluttering the cells a man might be mentally above all life's perplexities."

To have a thoroughly good circulation it is necessary for most people to activate it daily by a reasonable amount of exercise. In a series of 119 honor students, only 9 per cent limited themselves to required exercise, and the highest academic honors were in several cases won by those who also won highest athletic honors. But beyond the amount necessary to keep circulation active, additional exercise may not be as profitable as additional rest or additional study.

The brain worker usually will find it an advantage to take one period

of suitable exercise daily and to interrupt work for a moment or two every hour or so to stir up his circulation. The latter exercise periods should not be long enough to disturb "mental set." After brain work, similar light exercise is suitable before going to bed.

IMPORTANCE OF GOOD DIET. No matter how good the circulation of blood to the brain, if the blood does not contain nutritive materials such as the brain needs, it cannot function properly. To nourish the brain cells it is not necessary to take any special foods (e.g., fish), but merely to take a correct amount of a balanced diet.

As for quantity, the brain worker will need scarcely more food than he would require if he were sitting still doing nothing. Brain work does not increase the metabolism by more than 3 to 4 per cent. It has recently been demonstrated that the energy required per nerve impulse per gram is one ten-millionth of a small calorie. Benedict, one of the foremost students of nutrition, said, "The cloistered scholar at his books may be surprised to learn that the extra calories needed for one hour of intense mental effort would be completely met by the eating of one oyster cracker or one-half of a salted peanut."

Clinically it is evident that if a faulty diet (or other causes) lowers the percentage of sugar in the blood the brain is impaired in its function. Lack of ability to concentrate, restlessness, lapses of memory, irritability, and emotional instability appear, together with physical feelings of weakness and fatigue. The brain uses glucose; the blood coming from the brain contains less sugar than that going to the brain. It also produces lactic acid, which is removed by oxidation in the brain. These facts suggest that it would be wise for the brain worker not to be too long without food.

Qualitative aspects of diet also are important for the brain worker. It has been shown that thiamin is as important for the cerebral neurons as for other nerve tissue. A due supply of the various amino acids and minerals and possibly of the other vitamins is essential also.

IMPORTANCE OF EMOTIONAL ATTITUDES. It is clear that the desire for mental achievement must exist or even excellent brains may lie fallow. Individuals probably vary as much in the wish or the will to use their available brain power as in the amount available by heredity. Among those of high I.Q., however, there seems to be less variation in degree of motivation; usually they do desire to use their brains to the full. It appears that superior quality of brain may carry with it an increased "drive" to use it. But whatever the degree of intelligence, it is certain

that emotional factors may inhibit responses at the cortical level or, on the other hand, may stimulate them.

The important matter of motivation will not be further discussed at this point as it is the subject of a later chapter.

What Conditions Are Favorable for Study? Although individuals differ somewhat in the working conditions they find favorable for mental efficiency, most would agree that they do their best work when the following conditions prevail:

1. Vision is good, with or without glasses.
2. Lighting, whether natural or artificial, is adequate.
3. Position of the body is easy and uncramped, permitting full expansion of the lungs and favoring free circulation.
4. Temperature of the room is approximately 70° F.
5. Air in the room is in slight but scarcely perceptible motion and kept free of smoke.
6. Body is free of discomfort due to ill health.
7. Fatigue is not marked.
8. Digestive tract is neither too full nor too empty.
9. Genuine interest in work exists or can be aroused.
10. Emotional calm exists or can be established.

To this list of conditions many persons would add another—quiet. When this is important, it is one of the most important of all.

Another requirement for some is freedom from interruption for long periods. They find the relative proportion of work done in one long interval may be much greater than in an equal length of time in short intervals. Most good students, however, cultivate the habit of immediate concentration and learn to make good use of any available time.

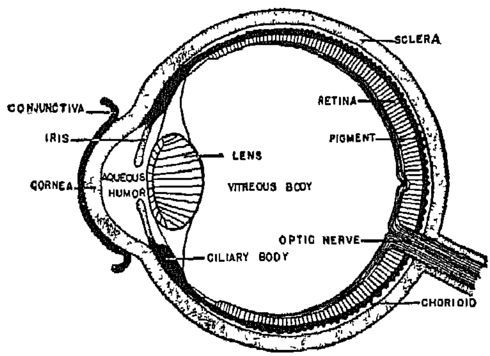
Apparently it is impossible to cause a mental breakdown by overstudy alone. The person who has a good mind and finds keen enjoyment in using it may, however, find it unpleasant to leave his work long enough to speed up his circulation by muscle work, to renew his powers by sleep, or to keep in touch with his friends in social life. If he fails to do these things, the lack of them may warp both his physical and mental condition, perhaps seriously.

Seeing

The visual apparatus consists of the eyes themselves; the optic nerves, one of which is attached to each eye; and the visual centers in the brain, to which the optic nerves extend. Vision depends primarily upon the

ability of the receptors of the optic nerves to respond to light. These receptors are located in the interior of the eyeball, a globoid structure, enclosing fluid.

The Eye: Structure and Mechanics. The eye is an optical instrument, not unlike the camera in principle. The walls of the eyeball (sclera and choroid coat) correspond to the box of the camera; the iris (colored part) corresponds to the diaphragm and admits a varying amount of light through its opening, the pupil, which is directly in front of the lens in the cross section of the eye shown here; the lens corresponds to the lens of the camera, which, like any lens, refracts or bends rays of light passing through it; and the retina corresponds to the sensitive plate or film, both



Median section of the eye of vertebrates.

containing chemicals in which light produces changes. In the eye, when the retinal end organs of the optic nerves are stimulated by light, impulses travel along the nerve to the visual centers in the brain, where visual impressions are formed.

Rays from far and near objects are focused upon the retina by the action of the lens which becomes thicker or thinner as required. (In the camera, focusing is accomplished by moving the lens nearer or farther away from the plate or film.)

The change in thickness of the lens is brought about by a small muscle (ciliary muscle) attached around the margin of the lens. Such changes occur when necessary to change the focus and are called the act of accommodation.

In the normal (emmetropic) eye, rays from objects at all distances can be focused precisely upon the retina. As shown in the diagrams, the mechanism of accommodation is used by the normal eye only for near vision.

Refractive Errors. Inability to refract light rays so that they focus upon the retina as in the normal eye is called a refractive error Three of the four refractive errors are due to faults in the shape of the eyeball.

NEARSIGHTEDNESS (MYOPIA). The eyeball is too long from front to back, with too great a distance between the lens and the retina. Rays focus in front of the retina. Near objects are seen clearly, but far objects

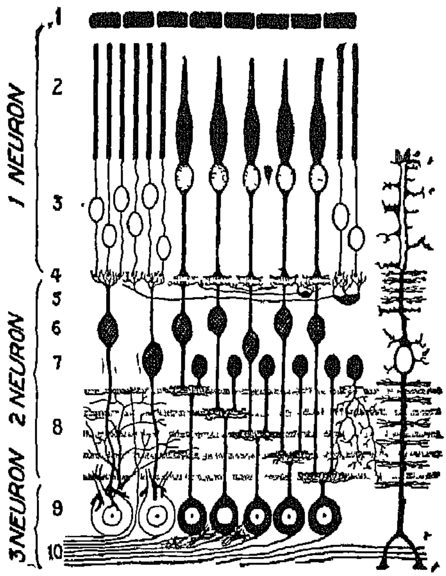


Diagram of the human retina, showing the relationships to each other of the retinal neurons, and their disposition in the different layers.

are blurred. Since the effect of the ciliary muscle is to thicken the lens and to bring rays to a focus farther forward, it is of no use in nearsightedness.

FARSIGHTEDNESS (HYPEROPIA OR HYPERMETROPIA). The eyeball is too short from front to back, with too short a distance between the lens and the retina. Rays focus behind the retina. However, contraction of the ciliary muscle causes rays to focus farther forward, and this enables the farsighted person to see well at all distances. But he continuously uses the mechanism the normal eye uses only for near vision.

ASTIGMATISM. The curves of the refracting structures are irregular, which prevents rays from coming to a focus at any one point. Vision is

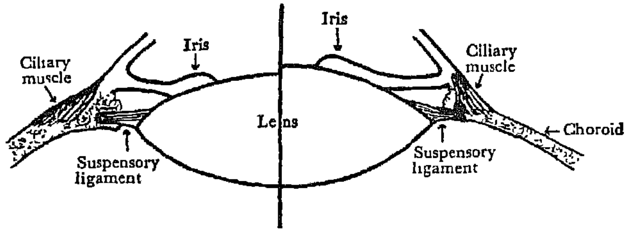


Diagram illustrating accommodation. (*Right*) The ciliary muscle is contracted, the suspensory ligament relaxed, and the lens thickened, for near vision. (*Left*) Conditions are the reverse, as in normal eye for distant vision. The diagram also shows contraction of pupil for near vision; note distance of iris from center line on each side.

blurred, although the individual may not be aware of it, never having seen clearly. This defect often is present with farsightedness; less often with nearsightedness.

PRESBYOPIA. The focusing structures have lost their flexibility with age, and near vision is not clear. This defect begins in all persons at 40 to 50 years of age. The first evidence of it is that print and work must be held farther away from the eyes than formerly in order to see them clearly.

Correction of Refractive Errors by Glasses. Eyeglasses are lenses worn in front of the eyes in order to change refraction so as to bring rays to a focus on the retina.

In myopia, concave lenses cause rays to focus farther backward and thereby make distant vision clear.

In hyperopia, convex lenses cause rays to focus farther forward, and thereby make vision clear at all distances without extra use of the ciliary muscle.

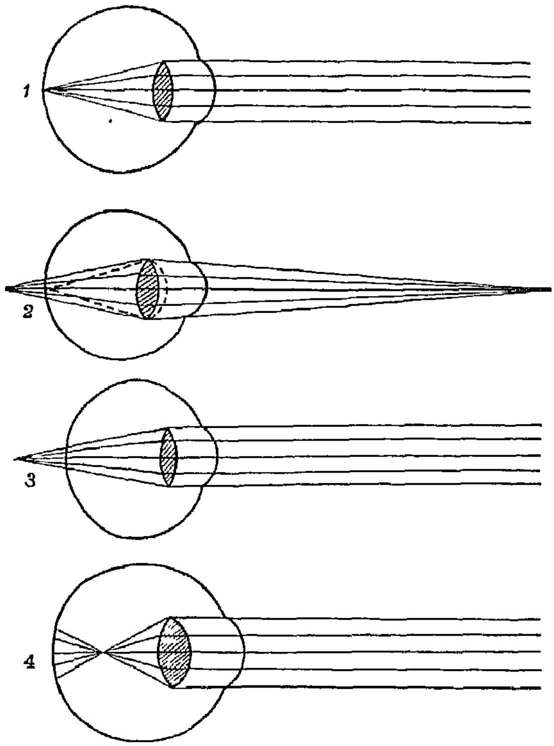
In astigmatism, compound lenses are used; they are made in such a way that their curves counteract each of the faulty curves of the eye.

In presbyopia, two pairs of lenses, or bifocal lenses, are required, one for distant vision and the other for near, since accommodation does not occur to any useful extent.

NEED FOR GLASSES. All those who have a refractive error need the appropriate glasses to make clear vision easy at all distances within range of human vision. Usually they should wear them constantly. There is a considerable amount of nervous strain in trying to see against odds, and mental work may suffer through limitations in the use of the eyes. In some cases the eyes may be injured by using them without glasses. For

many other reasons (e.g., accidents due to poor vision), those who need glasses should not try to get along without them.

Glasses are "crutches"—they do not change the shape of the eyeball any more than crutches for the one-legged grow a new leg. But each sort



(1) Normal eye, rays focussing on retina. (2) Normal eye accommodating for near vision, bringing rays to focus on retina. (3) Farsighted eye, shallow from front to back, rays falling behind retina. (4) Nearsighted eye, deep from front to back, rays falling in front of retina.

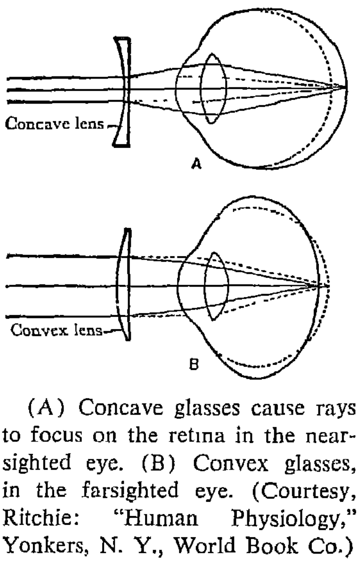
of crutch is of inestimable advantage in making an activity possible (i.e., seeing and walking, respectively).

Although exercises are useful to strengthen the eye muscles, no exercises correct refractive errors. There is no form of treatment that takes the place of additional lenses in front of the lenses of the eyes when refractive errors such as those mentioned are present.

Contact lenses serve the same purposes, but they require very careful fitting and are extremely expensive.

EYE EXAMINATION. All children should have the eyes examined before entering upon school life and from time to time thereafter, even though no defect is ever found. At any time in life, the eyes should be examined if vision is blurred; if the eyes feel painful, are inflamed, or become fatigued easily; or if mental concentration is unexplainably difficult. Occasionally, headaches are a symptom of uncorrected refractive error.

A physician who has specialized in the eye is called an ophthalmologist or occulist. Logically, such a person is the one to be entrusted with the care of one's eyes. No other persons than physicians are licensed to treat disease of the eyes.



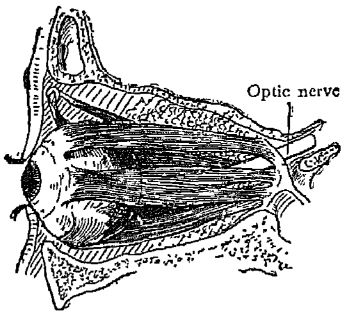
(A) Concave glasses cause rays to focus on the retina in the near-sighted eye. (B) Convex glasses, in the farsighted eye. (Courtesy, Ritchie: "Human Physiology," Yonkers, N. Y., World Book Co.)

After examining the eyes and finding a refractive error, the physician usually writes a prescription for glasses and requests that it be taken to an optician to be filled. The optician corresponds to the druggist in filling medical prescriptions. His work is that of grinding lenses (or having them ground under his direction) and fitting them into frames that will hold the lenses precisely centered before the eyes.

WEAR AND CARE FOR GLASSES CORRECTLY. To be effective glasses must be placed so that the optical center of the lenses and of the eyes correspond. This entails careful fitting and adjustment of the frames by the optician as well as readjustment by him whenever they become bent and as a routine every few months. Lenses wrongly placed before the eyes are likely to do more harm than good. The frames should rest comfortably upon the bridge of the nose and remain steady. There should be space between the sides of the nose and the glasses. The lenses should be kept clear—that is, free from finger marks, dirt, and scratches. They should be washed with soap and water usually several times a day.

Squint. The motion of the eyeball is produced by a set of six muscles so arranged that the eye may be turned throughout a wide range. These external ocular muscles normally act simultaneously, both eyes being turned in the same direction at the same time.

If these muscles are not of balanced strength, the eyeball is not held in the direction of vision but turns either inward or outward, giving the condition known as squint. The cross-eyed person does the greater part of his visual work with one eye, and the "turned" eye loses its vision partly or completely.



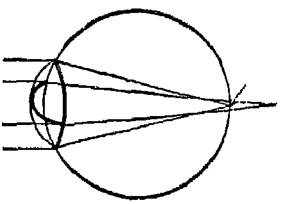
The muscles of the eye. (Courtesy, Ritchie: "Human Physiology," Yonkers, New York, World Book Co.)

Squint usually appears before the sixth year. If attention is given to it promptly, vision may be saved in a great many cases by glasses and by training. In other cases the remedy is surgery. At any time in life when squint appears or is present, it should be investigated by an ophthalmologist.

Conjunctivitis. Infection of the membrane covering the eyeball and lining the lids is called conjunctivitis. It occurs in epidemic form, called "pink eye." Also, it may occur as a result of transfer of the germs of a cold to the eyes. Frequently the eyes are infected by being rubbed with germ-laden hands or handkerchiefs.

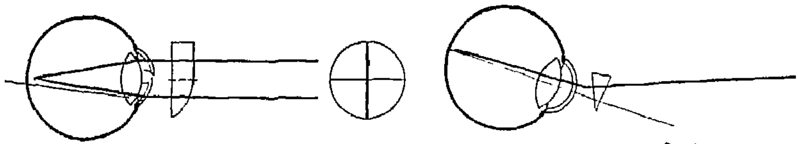
One of the serious forms of conjunctivitis is due to gonorrheal infection carried to the eyes by hands, towels, etc., or at the time of birth, from the birth canal of the mother to the child's eyes.

Any inflammation of the eyes should be investigated, for, if neglected, a simple conjunctivitis may become a serious infection of the whole eyeball. Furthermore, the symptoms of conjunctivitis resemble those of certain other serious eye diseases which may cause blindness (e.g., iritis or inflammation of the iris, glaucoma, etc.).


Astigmatism. No single focus can be formed.

A sty is infection of one of the small glands along the margin of the lid. The most important point in caring for it is to make sure that when the pus is discharged it does not contaminate and infect the eyeball.

Trachoma is a chronic, highly communicable virus infection of the lids, most common in those who live in poor unsanitary conditions. It causes 3 per cent of blindness. Although formerly considered virtually incurable it is now treated with some success by sulfa drugs.



Astigmatism and double vision

Removing Foreign Materials from the Eyes. When dust or any larger particles enter the eyes the normal result is an increase of secretion from the tear glands, which washes the foreign matter out over the lids or down through the duct to the nose. This will happen (unless the particle is deeply embedded) if one immediately closes both eyes and keeps them closed loosely, without rolling the eyeball, for a few moments. The eyes should not be rubbed. Many of those who present themselves to physicians to have particles removed from the eyes are suffering at the time not from the presence of the particle but from soreness produced by rubbing.

If a foreign body does not dislodge itself after an interval of waiting, a few drops of 4 per cent boric acid solution from a dropper may wash it away. As a last resort, a bit of sterile absorbent cotton or the corner of a clean handkerchief may very gently be brushed over it, if it is clearly visible. If the particle is not visible or if it cannot be dislodged easily as described, a physician should be consulted.

Chemicals in the eye—any chemicals—are to be diluted with water in large quantities which should be flowed gently over the eye, held open by the fingers, from the outer angles toward the inner.

What Should Be Done in Case of Accident to the Eye? A "black eye" is the result of contusion of the soft parts around the eyeball. Ordinarily it is not serious. If cold water is available at the time of the injury it may limit the discoloration. Later, hot compresses are likely to be more beneficial.

After a blow to the eye, whether or not it becomes discolored, medical aid should be secured without delay if there is any loss of vision, for detachment of the retina from the choroid may have occurred, and blindness in the eye may result, especially if treatment is postponed.

A wound of the cornea is particularly serious because of the opacity of the scar tissue by which healing takes place.

Chief Cause of Blindness. The diseases syphilis, gonorrhea, and tuberculosis are responsible for a large proportion of all blindness.

Syphilis alone causes 15 per cent. A fourth important cause is accident, especially accidents to children and to workers in industry.

About 12 per cent of blindness is due to glaucoma, a disease usually not occurring before middle life. Blindness from this cause can be prevented, if at all, only by early and expert treatment. The first symptoms are changes in vision (e.g., seeing radiations at right angles from street lights), with or without eye inflammation.

Blindness frequently is the end result of a special type of nearsightedness which is progressive (progressive myopia). Those afflicted with this disease can often avoid blindness by such training as is given in "sight-saving" classes and by care in the choice of vocation and avocations.

Those with squint may lose vision in one or both eyes, but such an unfortunate result is almost always preventable, as was mentioned on p. 142.

How Much Light Is Needed for Close Work? In arranging a room for study purposes, the desk and chair should be placed in proper relationship to both daylight and artificial lights. The important points are: (1) to have sufficient light on the work, but not a glare; (2) to have light on the work but not shining in the eyes.

When electric light is used it is thought better to have part of it diffuse throughout the room and part of it localized on the work. The most modern artificial lighting is indirect, reflected to the ceiling by opaque shades or moldings and from there into the room; or semi-indirect, reflected by semiopaque shades partly through them and partly from the ceiling. Satisfactory conditions may be secured by direct light, however, provided it is shaded so that the bulb itself is not within the range of vision and does not cause glare on the work.

The number of lumens or foot-candles of light required for various kinds of work varies with the fineness of the work and also with the color of the work and of the surroundings in the room (the darker they are, the more light they absorb).

For average purposes of study, 10 foot-candles of light usually are required on the work. Since the strength of the illumination varies inversely with the square of the distance, a tungsten lamp of given wattage at 2 feet will give only one-fourth the amount of light on the work as at one foot. A 100-watt bulb at 3 feet gives all the illumination that most people care for. A somewhat smaller amount of localized light would be satisfactory if enough diffused light were present also.

Ophthalmologists generally agree that subjective tests of lighting are reliable—that is, the correct amount for a given person under given conditions is that amount which enables him to see clearly and comfortably. Personal experimentation shows what that amount is. Light meters are useful in gauging the correct illumination for groups at work in large rooms.

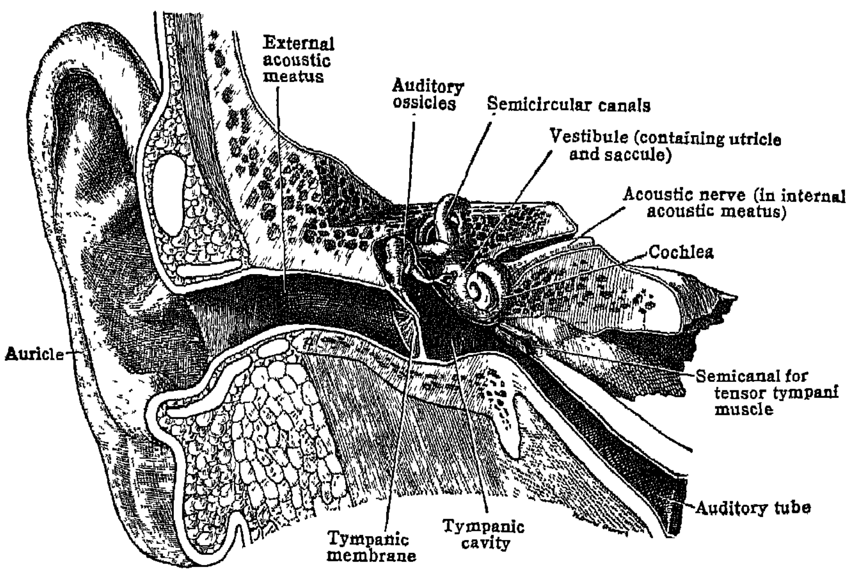
Those who require an unusual amount of light should have their eyes examined. It may be that they need glasses, or it may be that they lack sufficient vitamin A in the diet.

Fluorescent lamps are preferable to incandescent whenever the occupation requires very strong light. The lamp itself is of lower brilliance and therefore requires less shading; it produces less glare and fewer shadows; and it gives off less heat in proportion to light. If properly installed, so that the light does not flicker, fluorescent light is entirely safe for the eyes.

Hearing

The ears are complicated organs, as shown below. They have the function of hearing and also (semicircular canals) the function of helping to maintain equilibrium.

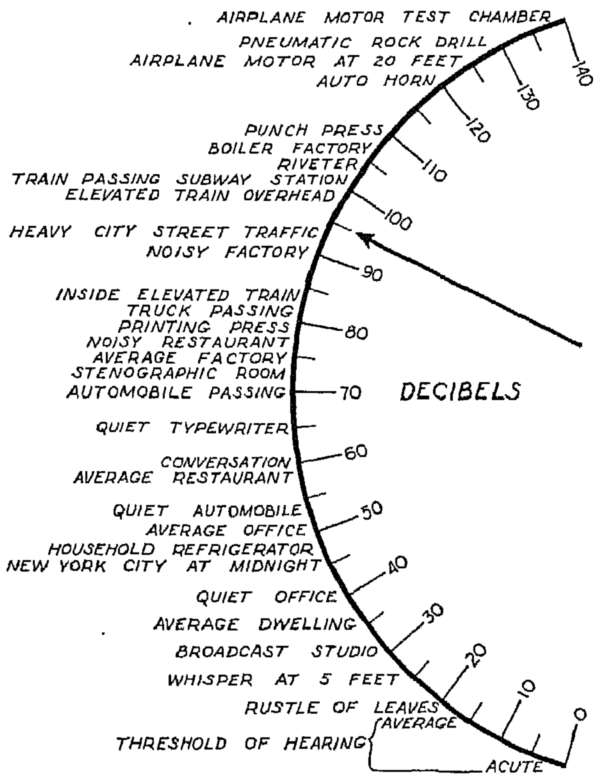
Deafness may arise from disease of any part of the organ of hearing



Dissection of the right ear, anterior half removed. Natural size.

or the two approaches to it (canal from the exterior and canal from the throat). Most commonly deafness is due to infection of the middle ear. Sound waves entering the external canal cannot set up vibrations in the ossicles of the middle ear if disease has made them immovable; therefore no vibrations reach the endings of the auditory nerve, and sound impulses are not carried to the brain.

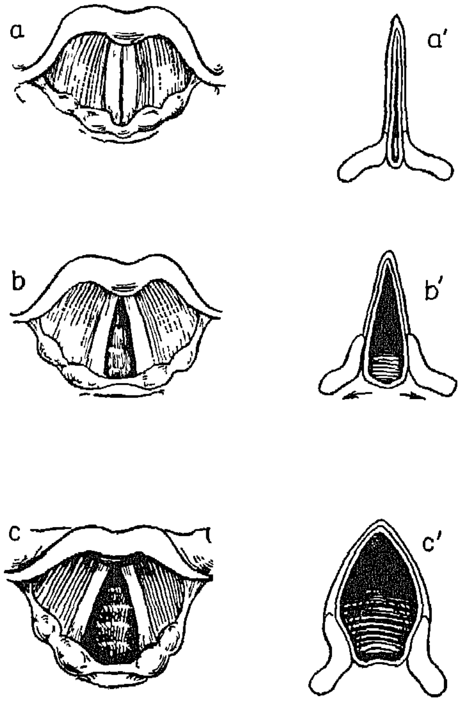
Infection of the Middle Ear. Middle ear infection (abscess) may occur during any disease in which the nose or throat is infected. The bacteria travel to the ear by the passage from the throat. A feeling of fulness in the ears indicates swelling of these passages, which closes them and gives negative pressure within the middle ear. When the middle ear is infected, fluid forms in it, which causes pressure and pain. When either of these symptoms arises, medical attention should be secured. The danger of permanent loss of hearing is so great that no reliance should be placed on home remedies, and no delay should occur. The extension of the



Intensity of noises. Typical noises as measured in decibels.

infection to the mastoid cells behind the ear often becomes a surgical matter.

The middle ear may become congested first and then infected as a result of chilling of the side of the head, as when a cold draft blows on the ear, especially when the head is damp.



(a) The glottis during the singing of a high note. (a′) The vocal cords approximated for the purpose. (b) The glottis during ordinary breathing. (b′) The vocal cords and their cartilages during ordinary breathing. (c) The glottis during deep inspiration. (c′) The vocal cords and their cartilages during deep inspiration.

Hygiene of the Ear. The ear requires chiefly to be protected from infection, according to the methods suggested. Particular attention should be given to the blowing of the nose, especially during an infection. Often bacteria are literally forced into the middle ear by holding the nose too tightly while blowing it. Also attention should be given to breathing while swimming and diving (i.e., not to breathe in while water is in the nose and mouth). Those who have ever had ear trouble are usually not per-

mitted to swim and dive. Since water may enter the middle ear from the throat as well as through the external canal, ear stoppers are of no use.

The external canal should be self-cleaning. If cerumen ("wax") accumulates in it, one should not attempt to remove it by any means other *than cotton wrapped around the end of a match.* Occasionally, it accumulates to such an extent as to interfere with sound conduction, in which case it should be removed by a physician.

Speaking

Mechanism of Vocalization. The larynx, at the lower part of the throat and the upper end of the trachea, is a cartilaginous boxlike structure for voice production. In men it is often conspicuous as the "Adam's apple."

Stretching across the larynx are two folds of connective tissue called the vocal cords. When small muscles connected with them contract, the vocal cords are drawn taut. Then when the outgoing air passes through them they vibrate and produce sound. The sound is modified by vibrations set up at the same time in adjacent parts.

How May the Larynx Be Protected? First, it is essential that the voice be properly used in speaking. Some persons "naturally" use the voice easily and well. For those whose voices are harsh, thin, rough, or easily fatigued, vocal training is desirable to enable them to breathe properly and to direct the current of sound toward the various resonance chambers of the mouth, nose, and sinuses. Enlarged tonsils, adenoids, or nasal obstructions should be removed if they interfere with voice production.

Second, the voice should not be used any more than necessary during an attack of laryngitis when the vocal cords are inflamed and the voice hoarse, or the quality of the voice may be permanently impaired.

6

Renewal of Energy

The body is physiologically so organized that it requires a balance of work and rest. To be at its best it should expend energy regularly and as regularly renew that energy by rest.

Fatigue

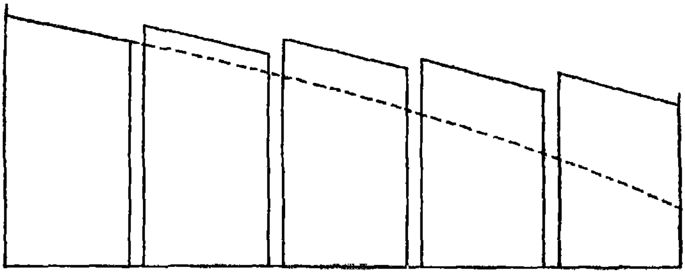
Fatigue is a state produced by activity. It tends to limit further activity; muscles either will not contract or will do so only feebly. Furthermore, fatigue usually causes discomfort which checks the desire for more activity.

Fatigue is largely a chemical state. When the body works, glycogen is burned, oxygen is used in the process, and metabolites (lactic acid, carbonic acid, and other substances) are produced from the fuel burned and from catabolic changes in cells. In the blood of a much fatigued person there is a lower percentage of glycogen and oxygen and a higher percentage of metabolites. These changed chemical conditions affect muscles and nerves in such a way as to cause both the disability and the discomfort.

Fatigue may also be an abnormal cellular state; if carried to an extreme degree, the cells of the fatigued parts, and indeed of other parts, may become structurally as well as functionally impaired.

Excessive Fatigue Versus Recovery. Fatigue is a normal part of the cycle work-fatigue-rest-recovery-more work. Working power comes through working, and it does not increase, nor even remain at the same level over a period of time, unless enough work is done daily to produce "healthy" fatigue.

If work and fatigue are excessive, however, and rest is insufficient, recovery of energy may not be complete, and working power may gradually wane. Furthermore, the whole system may be weakened if



Effect of rest periods in sustaining the energy output of gastrocnemius muscle of frog Curve made from ergograph record of electrically stimulated contractions, 45 per second for three minutes without interruption (broken line) and with four 3-second rest periods (solid lines)

overtaxed and underrested. Obviously, it is important to become fatigued only to a degree from which recovery is possible after a reasonable amount of rest.

During the rest that normally follows activity, most of the lactic acid is made over into glycogen; the remainder, with other metabolites, is excreted; the oxygen supply is restored; cells regain their normal state if they have not been too greatly damaged; the discomfort of fatigue disappears—and the body is ready to work again.

Tiredness and Its Causes. When the state of fatigue is present, the feeling of fatigue normally is present also. Like hunger and thirst, tiredness is a protective sensation which indicates a body need; it warns of the need to stop work and to rest.

Yet one may feel fatigued when one is not really so—that is, the body may be in a condition to work when one does not feel that it is. Feelings exactly like those of fatigue—and giving the same desire to stop work, or even not to begin it—may be present in those who are bored or worried or afraid, or who unconsciously cultivate tiredness in order to escape having to work. For example, one may feel too tired to continue studying an uninteresting subject but full of vigor for an evening of fun.

On the other hand, a feeling of fatigue may be absent when the body has worked to the point of exhaustion. This often occurs in those who have absorbing interest in their work or a great incentive to continue it. Marathon runners have reported that they were not at all tired until after they crossed the finish line or after they saw they had no chance to win. A person writing a book may not be aware of fatigue day after day if he believes he is doing a good piece of work.

Obviously, feelings of tiredness are not an infallible guide to the

amount of work to be done or the time to stop it, since they may be so modified by states of mind.

When one feels tired, the following questions may be asked:

1. Is the feeling of fatigue due to a real state of fatigue or to a state of mind?

2. If due to a real state of fatigue, is the feeling of fatigue in proportion to the amount of work done? In an extreme case (e.g., fatigue after climbing one flight of stairs) the answer to this question is easy. Obviously, a person fatigued by slight activity is unduly subject to fatigue, i.e., is unduly fatigable, and the cause of his easy fatigability should be investigated. Even in less extreme cases of fatigability it is profitable to search for the cause and to remedy it, for in the well person the degree of fatigue and the feelings of fatigue should correspond with the amount of activity (work or play).

Causes of Undue Fatigability. Undoubtedly the commonest cause of undue fatigability is incomplete recovery from previous fatigue—the body not having restored itself to working power.

The threshold of fatigue is lowered also in those whose musculature is poorly developed, in those who are malnourished, in those having a weak heart with poor circulation, in those with anemia, whose red blood cells are too few or deficient in iron, in those whom the endocrine glands, especially the adrenals, are not functioning properly, and in those suffering from infections and having bacterial toxins circulating in their blood.

All of these, and indeed most of those whose health is in any way impaired, feel fatigue too soon and too intensely.

Sedentary Fatigue. Muscular work no more vigorous than sitting at a desk or at the wheel of a car may give feelings of fatigue that seem unwarranted. The explanation is that in sedentary occupations a person is not entirely inactive. While making few large motions, he uses many muscles to keep himself stationary, and he produces metabolites, but he does not activate his circulation enough (by large motions) to remove the metabolites, and they remain in the tissues, causing discomfort. The impulse to "stretch" or to move about usually acts reflexly to relieve the situation. If not, voluntary attention should be given to the need of interrupting sedentary work rather frequently by vigorous large motions, preferably of the whole body. This has been shown to have a restful effect in many sedentary industrial and office occupations.

Decreasing Fatigability. The remedies for fatigability are obvious from

their causes. In many persons, all that is needed is extra rest for a time, or a better diet, or perhaps a little more exercise to increase muscle power and thereby resistance to early fatigue. In other cases, medical aid must be obtained.

A person should not be satisfied until he has done all that is possible to make his degree of fatigue correspond with his degree of activity.

Whatever the degree of one's fatigability, there is a point beyond which exertion cannot be carried further without danger. In the case of those who are weak, medical advice is needed on this point. For a few, any fatigue at all is unwise until health is improved. For others, a little fatigue is helpful, but more is harmful.

For the average well person there is a simple test for the amount of fatigue that may be permitted as a result of the day's activities—the rest test. Daily fatigue may be considered as within safe limits if it is banished by a reasonable amount of rest.

Rest

The established custom of the human race is, for adults, a diurnal cycle of approximately 16 hours of activity of one sort or another and 8 hours of rest in bed. The physiologic value of this custom is beyond dispute.

The question arises whether a similar alternation of rest and activity should occur during the waking hours. With most persons, the changes in energy output such as normally occur during the day provide periods in which little energy is used and some recuperation takes place. For example, bathing, taking meals, traveling by vehicle, and some of the forms of recreation, do not use a great deal of energy and may be restful in effect.

Nevertheless, periods of complete rest may be required in addition to restful changes of occupation.

Advantages of Rest Periods. Laboratory experiments show that muscular fatigue is postponed if work is interrupted from time to time. Studies of industrial work confirm these findings; productivity remains higher when periodic short rest periods are introduced in a session of hard work than when work is continuous. The same has been found true of office work. If rest periods are longer than a few moments, however, a second "warming up" period becomes necessary, and the total work output is decreased.

The president of a large insurance company, in an address on the characteristics of those who had lived longest, mentioned first that

Resting with pillow under the back, so placed as to favor expansion of the lower chest.

these people usually had the habit of resting periodically during the day. Such rest periods were often taken lying down; at the least, they involved complete idleness, with eyes closed and mind empty.

Rest is not to be scorned by the vigorous. Men on the march have long been taught that their endurance is increased if they stop every few miles to stretch out on their backs.

Nor is rest to be scorned by those who believe their work to be too important to be neglected even for a few minutes. Those having important work to do should be the most interested in keeping their energy level high. That this is often the case is shown by reports on a large number of business executives, 60 per cent of whom made a point of complete relaxation several times daily. They work while they work and rest while they rest and do not, like some students in the class room, turn their working periods into a continuous semisiesta.

"Bracing" Drugs as a Substitute for Rest. Drugs taken to enable one to continue work when fatigued do not lessen fatigue but simply mask it. The feeling of renewed energy after taking alcohol is an artificial one which may deceive a person into taxing his strength too far. Of the other drugs often taken, mistakenly, for their bracing effect, it may be stated that aspirin is a pain-relieving drug, not a stimulant; that coffee is a stimulant, but only very mildly so to those who are habituated to it, and therefore not of much use except to those who seldom take it; and that amphetamine (benzedrine in so-called "brain pills") is thoroughly unsafe for self-medication.

Sugar, which is quickly absorbed, adds to the available supply of energy-producing material and may check fatigue to the degree that it compensates for glycogen shortage. It is of use when blood sugar is low (as in some persons habitually and in others only after excessive physical activity).

The breathing of pure oxygen instead of air is "bracing" in a similar way, i.e., to compensate for oxygen shortage.

Practically, the field for the use of glycogen and oxygen is limited. In everyday life there is no substitute for rest at times when work has produced an uncomfortable or incapacitating or unsafe degree of fatigue.

Can the Will Be Used to Overcome the Need for Rest? Again, this is a question of masking the feelings of fatigue. It is possible to ignore such feelings when they begin to warn of the need of rest. Whether it is wise to ignore them is another matter—and one which the individual must decide.

It might be added that in emergencies when there exists a strong desire or need to work hard, the adrenal glands may increase their secretion to such an extent that fatigue does not occur so quickly (see p. 150). But to work perpetually at an emergency level is not to be recommended if it can be avoided.

The use of the will is of special value in ignoring feelings of fatigue not due to work but to boredom and the like. It is not always easy to decide, however, how much one's feeling of fatigue is genuine and how much is not—when to rest and when to spur one's self onward. Some individuals are constantly on the alert for reasons for doing little work, others for justification for overwork. An outsider, perhaps a physician, may help one to interpret an habitual inclination in either direction.

Sleep

There appears to be a physiologic rhythm that involves the nervous system, the glandular secretions, and the general metabolism, with sleep as one phase of this rhythm and waking the other. It has not yet been conclusively proved just why animals and man fall asleep and waken. Apparently a general condition of the whole body requires and brings about this periodic change from one state to the other.

During sleep a number of bodily functions are somewhat diminished. There is a reduction in the rate of metabolism; the pulse is slower; the temperature is lower, and the activity of the heat-regulating mechanism is reduced; the blood pressure is reduced; the rate of breathing is slower (although its depth is increased); certain secretions are produced in smaller amount (saliva, urine, tears); and the tone of the voluntary muscles is reduced almost to nil. Other functions go on as usual, including that of digestion.

One of the few functions that are more active during sleep is that of sweat secretion, which may be as great as during exercise.

How Does Sleep Renew Energy? It will be seen that sleep provides rest for a number of functions. That in itself would make sleep an advantage to the body, but it is not the whole story. What enables one to count upon waking refreshed every morning is the fact that during the night the body is the scene of active renovating processes. While the body's energy is not being used in outward activities, it is used for the repair of any tissues that have suffered from the previous day's wear and tear. That such repair processes actually do take place faster during sleep than during waking can be scientifically demonstrated. For example, the skin cells, which must constantly be renewed, reproduce about twice as often by night as by day.

However inert the body appears while asleep, it is actually the site of the most constructive and life-preserving activity. All tissues and organs of the body profit by their nightly seasons of up-building.

Sleep Requirements. Individuals are not precisely alike in the amount of sleep they require nightly to keep them in the best condition. It appears to be scientifically unquestioned, however, that the average adult must spend nearly one-third of the 24 hours in sleep in order to be in condition to live to the full the other two-thirds of the time. As someone has said, "The rest of your days depends upon the rest of your nights."

Those who are well and active and who continue to be so, year in and year out, usually report that they need from 7 to 8 hours of sleep, as regularly as possible. Those who try to get along on less are likely to become nervous and irritable, to lack the feeling of fitness, and often to become victims of this or that functional disorder. In addition, the ability to do mental work may become impaired.

Any undue need for sleep (i.e., more than 9 or 10 hours) may indicate either that fatigue has been too great or that some sort of ill health is present. The same is true of sleepiness at unusual times (e.g. in the morning at the time to waken or during the day). It should be investigated, both to correct the cause and, if possible, to avoid having to spend the extra time in sleep.

How to Fall Asleep. To be in bed at bedtime strongly predisposes to sleep as a result of habit. Probably the majority do not fall asleep instantly but only after a quarter to a half hour. Factors that promote falling asleep are bodily comfort, muscular relaxation, absence of stimuli of the senses of sight and hearing, and a mind at rest.

Those who have difficulty falling asleep usually are aided by one or more of the following measures: a small amount of exercise just before

going to bed, if one has been sitting still during the evening; a small amount of food, or a glass of warm milk, or a drink made of milk; and a warm, but not hot, bath.

Mental relaxation tends to accompany physical relaxation. If it does not, it is usually because one obstinately insists upon thinking. Instead, at bedtime one should let go the reins that keep the mind traveling along a planned route and allow it to wander idly or guide it into mildly pleasant paths of reminiscence or imagination. Light reading may be of assistance in composing the mind for sleep.

One mental attitude that is particularly likely to prevent sleep is the fear of not sleeping. Sleep is certain to come sooner or later—sooner, if one is not worried about it. In the meantime the fear of not sleeping may be banished by realizing that bed rest is nearly as good as sleep.

Drugs for sleep should not be taken except upon a physician's prescription. They are seldom needed by the well, and many of them are injurious.

Dreams and Sleep. Whether dreams make sleep less refreshing is hard to determine. Many of the most prolific dreamers awake refreshed after an average amount of sleep and apparently suffer no harm from their habit. Such has been reported as the personal experience of an eminent physiologist. In any case, there is no way of ensuring dreamless sleep beyond making physical, mental, and environmental conditions as comfortable as possible. Many people dream only when their bedroom is too hot, or they have eaten heartily and unwisely before going to bed, or have been through exciting experiences during the day or evening.

The material of a dream is pieced together from past and recent happenings, often forming fantastic scenes and incidents in which one figures in a role quite foreign to one's waking self.

According to one school of psychology (psychoanalysis), dreams have meaning as symbolic expressions of the unconscious self. Psychoanalysts state most definitely, however, that dreams do not mean what they seem to mean, nor do they mean just the opposite, nor indeed do they mean anything that could possibly be discovered by anyone who had not had the years of training necessary to master the highly specialized technic of psychoanalysis.

Recreation

Recreation may be defined as activity apart from the occupation and taken for pleasure. Although its connotation is pleasure, the derivation

of the word indicates that its original meaning was the meaning hygienists now assign to it—that of re-creation, of physical and mental fitness.

At times, throughout history, pleasure-seeking pure and simple has been in ill repute; it was thought to be a waste of time and somewhat sinful, however harmless the pleasure was in itself. But now it is known that merely as pleasure, recreation has a great deal to be said for it.

Even those with the most lofty aims at times need genuine relaxation from work. They find that recreation can be at one and the same time pleasurable and, in one way or another, useful.

Work versus Recreation. By definition, recreation is activity apart from work. A person who enjoys his work may, however, find so much pleasure in it that he feels no need for recreation and is tempted to stick to his work and to scorn amusements. He would do well to consider that swinging away from work from time to time may mean swinging back to it with renewed interest and power and, perhaps, with a better perspective upon it. Most hard workers who are successful in all lines make a point of "letting down" regularly, even to the extent of simple and childish play. A wise man is seldom a "fool for work."

It is believed that many ailments common in middle age, such as coronary disease of the heart, may be at least partly due to too intense application to work over long periods of time, plus the associated disregard for rest and relaxation, which is common in persons who live thus.

On the other hand, it is a great advantage to find pleasure in one's work. Somehow or other, a person should adjust himself to his work so that it supplies at least a good proportion of the necessary fun in life.

Choice of Recreation. The most vital choice an individual makes in determining his survival and his achievement may be his choice of recreation. It is as important to choose recreation to conserve and promote physical and mental vigor as to choose foods for that purpose. Large numbers of hard workers keep fit because they choose precisely the sort of recreation that suits them, both for pleasure and renewal.

From among the many activities that are entertaining and diverting, it should be possible to choose those that will not only renew one's zest for work but one's ability to work. To make such a choice the work itself must be considered first—the sort of energies it uses and its physiologic and psychologic effects.

Qualitatively, recreation should balance work, bringing different energies predominantly into action. Many occupations entail somewhat trying conditions, such as sitting still indoors for hours at a time, using

the eyes continuously for close work, and the mind for solving problems. Such conditions may be harmless throughout a lifetime to a person in good health provided that during the leisure time similar conditions are not continued.

Although the need for change from mental to physical activity and from indoor to outdoor is fairly obvious, it is not always realized how vital a matter it may be in a given case. Similarly, for the person who works alone at monotonous or intense work the greatest need may be for sociability in recreation. In general, the principle of contrast should prevail.

Quantitatively, recreation should use an amount of energy that does not bring the sum total of fatigue to too high a level. Many persons become gradually less and less vigorous in health, and some even break down as a result of their play rather than their work. For example, a little outdoor exercise goes a long way with some persons, and what they need is recreation of a quieter sort, giving them pleasure without wearing them out. To count the calories used in the daily life is as important as to count those received through the daily diet.

Beyond the actual use of physical energy is the matter of nervous tension and strain which may be associated with comparatively inactive recreation. This is a matter of individual reactions; for no apparent reason some persons are wearied by activities that are restful to others.

Effector and Receptor Types of Recreation. It is useful to distinguish between the effector type of recreation, which involves actively doing something with muscles or mind, and the receptor type, which involves passively receiving amusement through the eyes and ears. Most recreation can be classed as predominantly one or the other. Each has its place as a means of relaxation and renewal.

The effector types of recreation offer opportunities for satisfaction in the use of powers and, if chosen with due respect for the amount of energy available, are particularly valuable as a constructive force in personality as well as in health.

In the past few years all members of the freshman class in one of the colleges have been asked to name their favorite recreations. A majority (79 per cent) mentioned only the effector types, and 50 per cent gave only the various outdoor sports. But when presented a list of many forms of recreation and asked to check it, the majority of students were reminded that sports and games were not the only recreation they enjoyed. Sports still held the lead, but many students also expressed

an interest in the various arts (sketching, painting, playing on musical instruments, sculpture) and crafts (sewing, knitting, metal work, etc.), and in hobbies (dogs, stamps, gardening, photography, etc.). The total of those who favored these types of effector recreation was, however, too small in view of the possibilities of enjoyment they afford, both in youth and as age advances.

The receptor types of recreation offer change and enrichment of the content of thought while keeping the expenditure of energy at a low level. They are popular even among the young and vigorous and are the main source of amusement among many of the feeble and elderly. The movies and the radio together ranked first with 17 per cent of the college students mentioned and ranked high on the list for 41 per cent. If reading for pleasure were included, these three receptor types of recreation ranked nearly equal to outdoor sports. Undoubtedly their attraction is not entirely their pleasure value but partly the cultural enlightenment they afford.

Social or Solitary Recreation? For many people play is hardly play unless it is with somebody else. Of the college students mentioned, 84 per cent preferred companionship in any form of recreation, even in listening to the radio. Of course it is essential that individuals learn to live—to work and to play—in mutually agreeable relationships with others. In fact, this is one of the tests of mental health. On the other hand, it is just as essential that an individual enjoy his own society and have resources of his own for recreation by himself.

A tendency either to be too dependent upon others or to withdraw from one's kind as a regular practice suggests the need for revision of one's assessment of values.

Sports Are Desirable Recreation. Without thought of the benefits to be derived from them, many people choose sports because they like them. But for whatever reason sports are chosen, they are beneficial in many ways. First, of course, as outdoor exercise sports are usually an advantage to health. Second, they are psychologically and socially an advantage. The latter points need further elaboration.

Psychologically sports contribute to the ego's self-esteem by giving a sense of power in achievement. This is true especially after one has become expert, but it is also true even while mastering the technic in the early stages. Also, since sports are "the thing," to engage in them gives a sense of being like other people and being on a par with them (in that respect, at least, and to the degree that one develops skill).

Finally, sports are an emotional antidote against too much dwelling upon one's self and one's problems.

Socially, sports are perhaps the best means for developing the technic of getting on with others. Many a successful person owes his success to what he has learned on the athletic field about the need for and methods of coöperation. To be a "good sport" requires that one learn to be square with one's self and with others, to control display of emotions, to overcome pettiness, to bear disappointment, to meet defeat without blaming others, to be patient and persistent, to assume responsibility, and to make quick decisions. All these traits are of as much value in domestic, business, professional, political, and military life as on the athletic field. The term "good sport" is perhaps the most complimentary one that can be applied to any person, male or female.

As with all activities an interest may be overdone, even in the highly desirable sports, with detrimental effects upon health or upon work.

No one can afford not to spend some of his time, however, in various sorts of games. If a person does not like sports there is usually a special reason why he should learn to do so, if he would enjoy the best health and have a well-balanced personality.

To become addicted to sports, it is desirable to take them up in youth, so as to become at least moderately expert at a time when skill is most easily acquired. In college it is well to choose at least one sport to be played with others, for the sake of the social and psychologic benefits that have just been mentioned, and at least one sport that may be enjoyed alone (e.g., swimming, golf, skating) so that in after years opportunities for sport will not be lacking even if companions are.

Recreation as a Doctor's Prescription. Since play uses precisely the same bodily and mental energies as work and produces the same varieties of effects, modern preclinical medicine analyzes an individual's play habits as carefully as his work habits and all his other habits. In a given case a physician may find that a particular sort of recreation is doing harm and that another sort would be helpful. Therefore, he prescribes recreation suited to the individual's needs and tastes.

Furthermore, physicians are interested in the way their patients spend their vacations. In fact, vacational guidance, if more generally utilized, would be of as much value in its way as vocational guidance.

7

Regulating Body Temperature

Thermostatic Control

A body temperature favorable to survival is one of the fundamental needs of all living things. Many species of lower organisms are dependent upon being in an external temperature that is favorable, for their body temperature tends to correspond with the temperature of the medium in which they live (air or water)—that is, they are poikilothermic. Since they become cool in cool media they are called "cold-blooded," but they also become hot in hot media.

With man and some of the higher animals the situation is different; they maintain a relatively constant body temperature, varying but little regardless of external temperature—that is, they are homothermic.

Man's Body Temperature. Man has a normal temperature of about 98.6° F. when measured by the clinical thermometer in the mouth and can maintain that temperature if healthy while living in climates ranging from arctic to tropic, and can survive short exposures to temperatures from 50° below zero to 250° above. This is made possible because of an automatic system to maintain temperature.

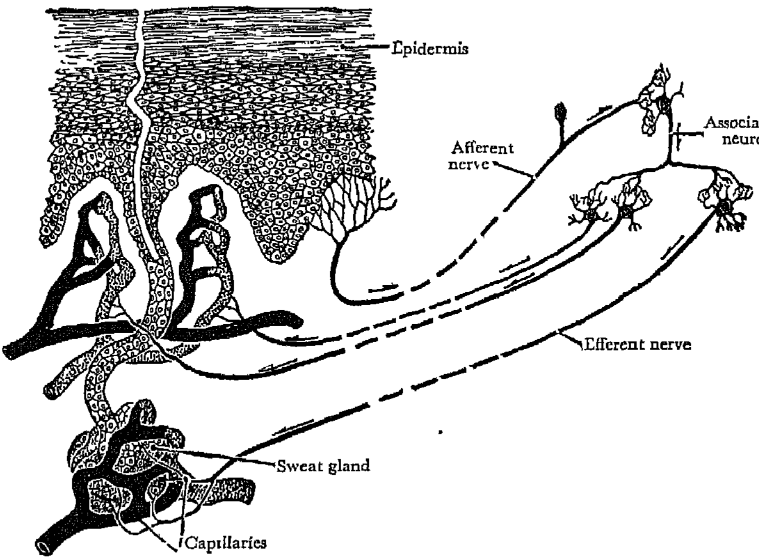
HIS HEATING SYSTEM. Heat is produced in the body by every active cell as an accompaniment of activity. Naturally, the most active cells—those that carry on the greatest amount of oxidation—produce the most heat. Since the muscle cells are the most numerous of the active cells, they may therefore be looked upon as the "fireplaces" of the body. They are constantly in action to some extent, whether the body is moving or not. Even at rest, the body produces more heat than it needs to keep its temperature 98.6° F.; when active, it produces a still greater excess of heat. During activity such as playing 18 holes of golf, enough heat may be produced to raise 1 ton of water 1° C.

A small increase in body heat results from taking food, chiefly because the digestive organs become more active while digesting it, and this adds a little to the combustion going on in the body. If food or drink is taken hot, the body acquires a small amount of heat in that way.

HIS COOLING SYSTEM. The body obviously is equipped to overheat itself grievously and would do so if it were not also equipped to cool itself adequately. The situation is much the same as with a gasoline engine that consumes fuel, generates energy, becomes heated, and requires a mechanism for cooling.

Excess bodily heat is given off largely through the skin and to lesser extent through the lungs.

Cooling at the surface of the body takes place in four ways. First, heat is given off by radiation, as from all heated objects, such as the sun or a hot stove. That loss of heat takes place in this way from the body is shown by the increase in temperature in a room in which a person is enclosed. Second, heat is given off by conduction, as from any heated object to a cooler object or substance with which it is in contact. The body when in contact with ice is cooled to the same degree that the



A diagram illustrating the nervous mechanism of temperature regulation in man. The quantity of secretion of tubular glands (and consequently the amount of sweat which may evaporate to cool the body) depends upon the quantity of blood in the capillaries associated with the glands and dermal papillae. Through a reflex arc the circulation is regulated by the temperature of the skin. (After Hough and Sedgwick.)

ice is warmed and melted. Third, heat is removed from the body by convection—that is, virtually blown away on currents of air. Fourth, body temperature is lowered by evaporation of moisture from the skin. This process takes place in a quiet atmosphere but is more rapid when aided by convection.

The lungs also take part in cooling the body. First, evaporation of moisture occurs from the air passages, as shown by breathing upon a cold object upon which moisture will condense. Second, the lungs take in air cooler than the interior of the body, and they lose heat to the same extent that the air is warmed.

A small loss of heat also occurs when the digestive tract gives up heat in warming cool food and drink.

The total loss of heat from the body by these various routes in the case of an adult sitting in average clothing in a room at 70° F. will be approximately as follows:

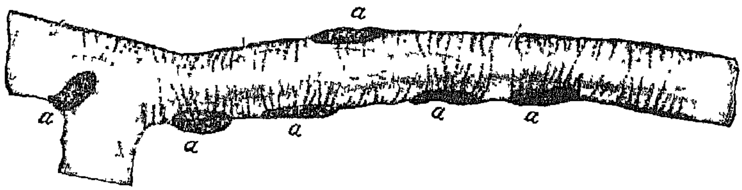
By transfer and evaporation from the skin	85 per cent
By evaporation from lungs	10 per cent
By transfer to air, food, and drink	5 per cent

HIS BODY'S THERMOSTAT. The tendency of body temperature to remain at about 98.6° F. is due to a balance between heat produced and heat lost. To maintain this balance there exists in the body an automatic mechanism which may be likened to the thermostat which governs temperature in a house.

The body's thermostat consists of a nerve center in the brain which is stimulated through sensory nerves from the skin, conveying messages of heat or cold, and through the temperature of the blood flowing through it. When the body begins to be overheated or overcooled, appropriate messages are sent out from the temperature-regulating center to increase or decrease the loss of heat or the production of heat.

Five Functions Affecting Temperature Regulation. From the temperature-regulating center, five functions are activated whenever the body temperature threatens to become too high or too low.

1. VASOMOTION, or change in the caliber of the blood vessels in the skin. Since the skin is almost always cooler than the blood, blood coming to the skin from the warmer interior will be cooled and vice versa. At need, the skin blood vessels either contract or dilate so as to admit either less blood or more blood, thereby checking or increasing the degree of



Rouget cells; plain muscle cells in capillary walls (*a*).

cooling at the surface. Vasomotor changes are first noted in the face, hands, and feet; then in the arms and legs, later, in the trunk; and last in the forehead.

2. Secretion of Sweat. Sweat is constantly being secreted imperceptibly. At about 66° F. the amount begins to increase and at about 70 to 80° F. in men and about 80 to 90° F. in women, visible perspiration usually appears. The more sweating the more cooling by evaporation at given atmospheric humidity.

3. Respiration. Breathing automatically becomes faster as the body becomes warmer and vice versa. Increase of respiration for cooling purposes is more marked in certain animals than in man; for example, dogs, who have few sweat glands except on the pads of the feet, pant on hot days to cool themselves by evaporation of moisture from mouth, throat, and lungs.

4. Muscle Action. Automatically the muscles become more active when the environment is cool, so as to increase heat production. This is made evident in shivering (involuntary contraction of small groups of muscle fibers), chattering of the teeth (jaw muscle contraction), and "goose flesh" (contraction of the minute muscles attached to hair roots). Shivering is important in man, not only for the heat it creates, but also as a warning to use voluntary methods for warming up. "Goose flesh" is important in the hairy animals, for bristling of the fur increases its insulating properties. When necessary to reduce heat production, reduced muscle action occurs to a small extent in a hot environment, but there is a minimum below which heat production cannot go, for which reason changes in muscle activity are not so important in hot weather as in cold.

5. Endocrine Secretion. The glands that affect metabolism most —the thyroid and the adrenal medulla—change the amount of their secretion to vary the amount of heating or cooling that is required, an increase producing more heat and vice versa.

The Danger of Overheating. Moderate overheating may cause body

temperature to rise slightly before it is corrected and may produce such symptoms as headache, feeling of physical and mental inertia, lack of appetite, and indigestion. If overheating continues over a long period, as in a tropical environment, outdoors or indoors, the total effect may be a general depression of all vital processes.

Severe overheating causes heat stroke (or, if from the sun, sunstroke), heat exhaustion, and heat cramps.

1. In heat stroke or sunstroke, body temperature rises; the skin is flushed and hot, the pulse strong, and the victim usually is unconscious. The remedy is cooling him as quickly as possible (i e., removing him to a cool place and pouring cold water over him). The head should not be low. Nothing should be given by mouth during unconsciousness, nor later, except by medical advice.

2. In heat exhaustion, the temperature does not rise, but falls; the skin is pale, cool, and moist, the pulse is weak, and the victim is conscious, unless he faints. The remedy is warmth, quiet, stimulants, and salted water.

3. Heat cramps are due to dehydration of the muscles and loss of salt by excessive sweating. They can be prevented and relieved by taking water with a pinch of salt to the glass.

Who Are Susceptible to Bad Effects of Heat? Heat stroke and heat exhaustion occur especially when atmospheric temperature and humidity are high and air motion is slight; sunstroke occurs with similar atmospheric conditions, plus intense sunlight. Persons most susceptible are the very young, the aged, the feeble, the obese, the undernourished, the alcoholic, those who perspire uncommonly freely (thereby losing much water and salt from the body), and those who do not perspire freely enough (thereby not cooling enough by evaporation).

Even the well may not adapt successfully to extreme heat if exposed while overclad, just after a hearty meal or after missing a meal, while asleep or unconscious, under the influence of alcohol, or if they are too vigorously active at work or play in the heat.

Fever. Fever is a derangement of temperature regulation. It is usually brought on by infection, but may occur in other circumstances—for example, after a severe burn or an extensive wound.

At the onset of a fever, the blood vessels in the skin contract, giving chilly sensations. The coolness of the skin may even excite shivering, even though the interior of the body is warm. Some infections, notably pneumonia, are regularly ushered in by one or more chills. A profound

infection of some sort should always be suspected when the body undergoes a "shaking chill."

Shortly after the onset of a fever, the skin becomes warm, dry, and flushed, and the mucous membranes become hot and dry, exciting thirst. The rate of respiration and pulse is increased.

Fever is a protective mechanism in infection. It appears that it serves the useful function of weakening the invading germs by increasing the activity of the reticuloendothelial system, thereby promoting phagocytosis, and by increasing the rate at which immune bodies are produced. Also, it changes certain physiologic functions in such a way as to be of assistance—for example, the increased rate of heart and respiration mobilizes the body's forces more rapidly.

Obviously, it is not desirable to dose one's self with medicines to reduce a fever. To lower the temperature not only deprives the body of the benefit of the fever, but also the drop in temperature may be wrongly interpreted as meaning that the illness is over, causing a person to go out while he is still ill. That is the chief objection to taking aspirin for a cold.

Many of the changes that take place in the body during fever are, however, potentially harmful unless they are counteracted. It is necessary to stay in bed during fever to avoid further increase of an already greatly increased metabolism. Also, it is necessary to take plenty of fluid in order to promote excretion. During fever, protein substances in protoplasm undergo the greatest catabolism, and albumin and other nitrogenous substances appear in the urine. At the same time, more fluid than usual is retained in the tissues. Therefore the urine becomes concentrated and wastes may be retained unless the fluid intake is greater than usual. Finally, plenty of food of a nutritious and easily digestible sort is required to offset the losses due to increased metabolism. Wasting occurs in prolonged fevers if the diet is not adequate.

The Danger of Overcooling: 1. FREEZING. An ordinarily well person in proper condition can be exposed to very low temperatures even for a long time without suffering harm from it.

Freezing of the body as a whole is not common except in those who become unable to move while exposed to extreme cold, as after a disabling accident, or while unconscious, as during alcoholic intoxication. It is reported that one-fourth of those in this country who freeze to death are under the influence of alcohol, and nearly all the others have been victims of accidents.

For the victim of long exposure to extreme cold, warming should not be too rapid. This applies also to local freezing, frostbite, as of nose, ears, fingers, and toes.

2. General Chilling. Chilling consists of a drop in body temperature, which may be either diffuse throughout the body or local. General chilling occurs less often in those who keep in motion, maintaining their heat production, than in those who are inactive in the cold.

When quiet, any conditions that favor too rapid and pronounced cooling by either transfer or evaporation may lead to chilling. It is particularly likely to occur (1) when the body has become much overheated (from external warmth or from clothing) and then is too rapidly cooled; (2) when the surface of the body is damp (either from rain or snow or from perspiration) and the dampness is allowed to evaporate too rapidly; (3) when the body remains for a long time in contact with a medium cooler than itself (cold air, cold water, cold ground, etc.) to which medium the body heat is transferred by conduction; (4) when the body is exposed to a strong current of air, either when insufficiently clad or when damp.

The corollary of less blood in the skin is more blood in the interior. This may amount to congestion of internal organs. When the organs are congested, their function is likely to be disturbed and they also become more susceptible to infection. Any organs, especially the lungs, kidneys, and female reproductive organs, may be disordered as a result of chilling. Undoubtedly much illness is due to exposure to cold to which the body is unable to react protectively.

3. Local Chilling. It is particularly difficult for the body's thermostat to govern the distribution of blood as between the exterior and the interior, so as to keep the interior at an even warm temperature when one region of the body needs warming and the rest, cooling. In fact, it often fails to do this, and the part that needs to be warmed remains cool. Congestion may occur in organs underlying the chilled area.

Such congestion may be followed by inflammation and possibly infection. For example, an ear abscess may occur after chilling of the head, as by going out into a cool breeze with the hair damp, or an attack of lumbago (pain in muscles of the back) after sitting with a breeze from an electric fan blowing on the back, or facial paralysis, while lying at night in a cold draft.

In some cases, local chilling so disturbs the temperature regulating mechanism that remote parts are affected, as in the case of menstrual

disturbances following wet feet. The head, the back of the neck, the back, and the feet seem most susceptible to local chilling.

Rapid warming is the remedy for chilling.

Subnormal Temperature. Following an illness with fever the temperature is likely to be subnormal for a time because of disorder of the overworked thermostatic system. In such cases, the tendency to perspire readily may continue, and the body may be especially subject to chilling on slight exposure. Subnormal temperature is not common in other circumstances except in the feeble and undernourished, in which case temperature may be normal except in the morning. When constantly subnormal, an endocrine disorder—subject to treatment—may be the cause.

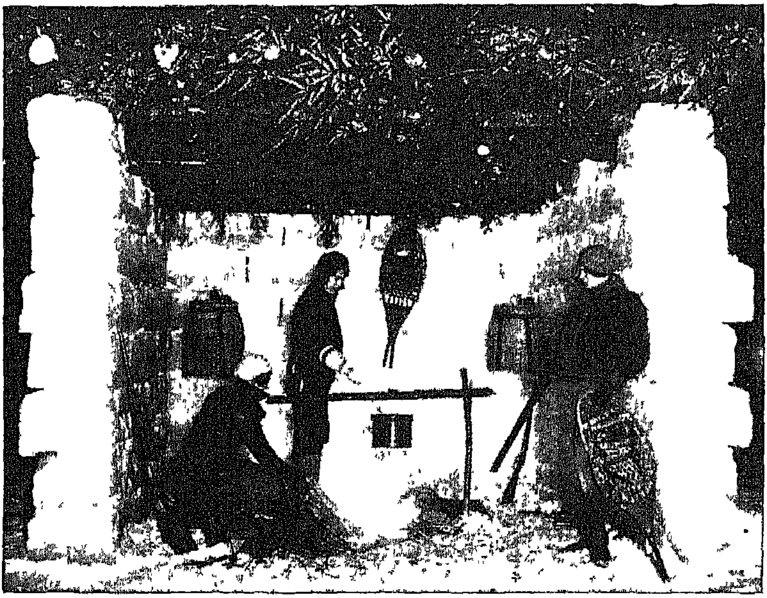
Voluntary Adaptation to Cold and Heat

Obviously, when the automatic mechanism is working against odds, voluntary assistance is important in order to make results more certain and to spare strain of the functions involved. Difficulties may arise in both outdoor and indoor conditions.

Aiding Adaptation to Cold Weather: 1. CLOTHING. No clothing actually adds heat to the body; it conserves body heat by preventing undue loss of heat. Other things being equal, the "warmest" materials are those that have served animals in the same way—wool, camel's hair, vicuna, fur, and leather. Certain synthetic materials are "warm" because of their weave.

Enough clothing should be worn to conserve the requisite amount of heat but with two precautions. First, the amount of clothing should not be so great as to induce perspiration (except during great activity) and, if such occurs, precautions must be taken not to become chilled by too rapid evaporation when activity ceases. This usually means keeping active and wrapped up while cooling occurs gradually. Second, the amount and design of clothing should not be such as to weigh the body down or cramp free motion. Wool materials so woven as to enmesh air afford excellent insulation and are light in weight. Closely woven wool is less permeable to wind and rain and on that account is often chosen for men's outer garments. They need not be too burdensome if well fitted at the neck and shoulders. Rubber and leather coats, being entirely impervious, are useful if worn over absorbent materials to take up the body's moisture.

2. EXERCISE. Activity is an important means of preventing serious



Body temperature may be maintained by exercise despite extreme cold. (Photograph from Wide World Photos.)

results when chilling or freezing threatens. To keep moving may be life-saving

The habit of taking exercise in the cold has a good effect upon health. First, it tends to increase one's ability to adapt well to cold. If one lives in a cold climate or in a climate with cold seasons, one cannot safely remain indoors too steadily, lest one's response to cold will be poor when one does go out.

Second, the responses the body makes to cold have a stimulating effect upon the whole system. Through increasing metabolism and circulation, cold furnishes some of the same benefits as exercise. The superior achievements of dwellers in temperate climates, as contrasted with tropical or arctic, is attributed to the stimulating effect of the changes of weather and the frequently necessary responses to cold.

3. Baths. Cold baths taken in the morning promote the body's ability to adapt to cold—that is, are "toughening"—provided the individual reacts well to them.

Warm baths conserve body heat and are useful after exposure to chilling conditions, but, because they warm the skin, too much cooling may take place if exposure to cold immediately follows them.

4. DIET. Body temperature will be maintained even on short rations until a starvation level is reached, but the necessary vitality to react well to cold is not furnished except by a full diet It is also desirable that some of the food or drink at each meal on cold days should be hot, for this adds slightly to body heat.

Aiding Adaptation to Hot Weather. The precautions to be taken in hot weather are not precisely the opposite of those for cold weather

1. CLOTHING. The coolest materials are those from the vegetable kingdom—linen, cotton, rayon, and other synthetic silklike materials. Silk is intermediate between these and the warm materials previously mentioned. Open weave, admitting air, obviously is cooler than close weave. Precautions regarding chilling when the body is damp from perspiration are as important in summer as in winter.

2. EXERCISE. The body's cooling process usually will dispel excess heat produced by exercise in summer, provided the excess is not too great and the physiologic condition is favorable (see p. 163).

3. BATHS. The heating or cooling effect of baths usually is compensated for at once if the bath is not long. A long cool bath, however, even in hot weather may prove chilling. It is generally agreed that it is not desirable to plunge into very cold water when overheated, nor to remain too long in it without swimming.

4. DIET. Summer diet need not be quite so abundant as in winter, for the caloric requirement usually is not so great, and large meals may not be digested as well as in winter. It should contain at least the required amount of protein and fat but may contain much less carbohydrate than in winter. Although cool or cold food and drink help one to keep cool, an excess of iced food or drink at a time may cause thermal shock of the stomach.

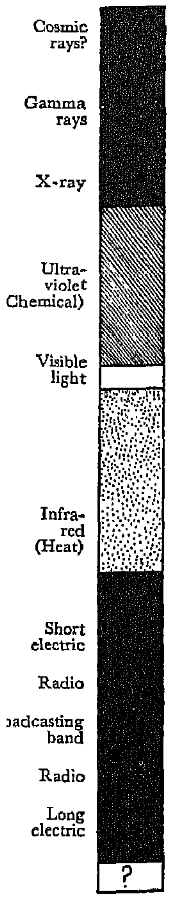
Effects of Sunlight

Since the heat of the sun sometimes is responsible for upsetting the regulation of body temperature, causing sunstroke, severe sunburn, and heat exhaustion (p. 166), the many benefits of sunlight should be mentioned, as well as the few other dangers besides the danger of overheating.

The Sun's Rays. The visible light-giving rays of the sun are accompanied by the invisible heat-giving infrared rays, which do not burn, and by the healthful but burning ultraviolet rays, likewise invisible. These various rays are shown with other rays of the spectrum on p. 172.

Visible light aids health indirectly since it cheers the spirits and, by making dirt visible, promotes cleanliness.

Infrared rays either aid health or harm it, depending upon whether the body needs more heating or less. These rays, from the sun itself or from incandescent or other lamps, are often used as heat treatment for abnormal conditions such as congestions or muscle or joint disorders.



Complete spectrum.

Ultraviolet rays aid health in several ways which will be discussed.

Ultraviolet Rays. The benefits of exposure to sunlight are due largely to the effects of ultraviolet rays. First, they have a generally stimulating or tonic effect upon the body, provided the individual does not become overexposed. Many a person is familiar with the sense of buoyancy and well-being after a "sunning." With some other persons, long exposure to sunlight proves too stimulating. Those who are "nervous" already may be made more so. Those who are ill might also be harmed and should consult their physicians before giving themselves too generous doses of sunlight.

Second, ultraviolet rays have a nutritive effect in that they cause vitamin D to be formed in a fatty substance in the skin. In children this is of great importance, for children need much vitamin D and can hardly obtain as much as they need from food alone. In winter or in cloudy climates, the alternative to sunlight must be a food supplement such as cod liver oil. Adults need less vitamin D but may not obtain even that small amount from food. It should be noted that the excess of vitamin D formed in the skin during the summer is stored there and given off gradually. In the case of adults well sunned in the summer, the stored amount may be enough to last through the winter.

Third, ultraviolet rays have a germ-killing effect, but since these rays do not penetrate beneath the surfaces, they are useful only for skin infections, and not even for all such. Among the infections most helped by sunlight is acne, "pimples" (see p. 184). Yet it would be well for a person with a skin disorder to consult his doctor before trying to treat it by unusual exposure to the sun.

How May Enough Ultraviolet Rays Be Obtained? Ultraviolet rays do not pass with full strength through clothing and do not pass at all through ordinary window glass. Therefore, outdoor exposure of the bare skin is necessary. Even so small an area as the face admits some ultraviolet rays but not enough to meet the needs of young persons.

Artificial sun rays are given off from lamps using either a mercury vapor arc or a carbon arc. Large ultraviolet lamps in professional use may deliver even stronger radiation than the sun itself. These powerful instruments are valuable for the treatment of many ills when used under medical supervision. They are also used as a measure of hygiene under conditions when enough natural sunlight is not available. Some industries use them for workers in the dark, as in mines. Small sun lamps for home use are available but should be used only according to medical advice. Some of the lamps sold to laymen are satisfactory and some are not.

Danger of Sunburn. Upon exposure to sunlight, most persons develop a coat of tan, which consists of pigment granules that increase in number in the pigment-bearing cells in the skin. Being opaque, the pigment protects the deep layers of the skin. Also, the outer layers of the skin thicken under the influence of sunlight, and this also protects the deeper layers.

If exposure to sunlight is excessive, sunburn may occur before the skin's two protective responses have come into action. The result may be a rather deep burn, after which the skin may never quite regain its previous quality. Those who are repeatedly exposed to strong sunlight develop a chronically abnormal skin, dark or ruddy in color and of leathery thickness and texture. Such an oversunned or "weatherbeaten" skin seems to be especially susceptible to cancer.

One must realize first that the ultraviolet rays are burning rays but not hot rays. They may burn even on an "overcast" day when the skin does not feel at all warm. Second, burns by ultraviolet rays do not appear at once but several hours later. If a person remains in the sun until the skin is red, he may have remained there much too long. Third, ultraviolet rays are reflected from white sand and from bodies of water and reach the skin from these reflectors with intensified force. It is even possible to become sunburned in midwinter by sunlight reflected from snow while at a high altitude. Fourth, ultraviolet rays are stronger in the middle of the day than in early forenoon and late afternoon, and stronger in the middle of the summer than earlier or later

in the warm season. Fifth, the nearer the equator the stronger the ultraviolet rays.

With these facts in mind, those who are free to govern their exposure to sunlight should be able to regulate time and duration of exposure so as to derive benefit rather than harm.

Protection Needed Against Exposure. For those who are necessarily overexposed to sunlight, especially for blonds and "redheads," whose skin usually is sensitive to sunlight, there are protective creams containing chemicals that absorb some of the sun's rays. These are to be applied before exposure, especially to the skin of the face.

While out in strong sunlight, a hat with a brim should be worn for the protection of the brain and of the eyes. When sunlight is particularly glaring, the eyes may be further protected by use of standard absorption lenses, which filter out some of the sun's rays. Ordinary tinted glasses do not serve the same purpose and, moreover, may do harm, for the cheaper varieties are of wavy, imperfect glass.

Since the sex glands are especially sensitive to sunlight, "shorts" should be worn during allover sun baths.

Petroleum jelly (vaseline) covered by a soft, clean cloth will give relief and aid healing in most cases of mild sunburn. If the area is extensive or if blistering occurs, a physician should be consulted.

Indoor Climate

The major problem arising from our habit of living indoors is to keep warm but not too warm in winter and to keep cool but not too cool in summer. There are other matters that are worth consideration in respect to indoor air, but the prime matter is that of temperature.

Why Is Temperature of Prime Importance Indoors? In 1920, Dr. C.-E. A. Winslow, a leader in the study of indoor atmosphere, gave as the first characteristic of good air a cool temperature. All experimental and statistical work since then has confirmed his view. More than ever it is now clear that bad indoor air is air that is too warm.

The accepted standard for room temperature in dwelling houses with natural humidity is approximately 70° F. at 5 feet from the floor, on a thermometer located where it will register correctly—that is, not near a window or radiator and not on an outside wall. This temperature should be comfortable for the normally vigorous person suitably clad and at rest. The optimum temperature is within a degree or two of 70° F., women usually preferring it a little above and men a little below.

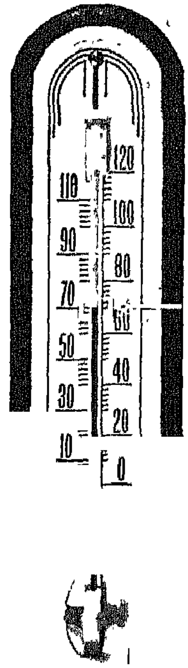
The temperature standard was reached as a result of subjective tests of the comfort of individuals and objective tests of their fitness and productivity in so far as it could be definitely related to temperature. Statistical reports are available from many sources.

In too warm a room, many people experience sluggishness of mind, inability to concentrate on work, either restlessness or sleepiness, a disinclination to work and a tendency to stop work, and headache or a "stuffy feeling" in the head.

It has been learned through experiments in stores, factories, and schools that people not only tend to feel better but also to work better if the temperature is within the optimum range. Although power may not actually be diminished if room temperature is too high, the zeal for work usually is diminished. Therefore, because of mental and physical inertia, less work is likely to be accomplished in too warm a room.

It is clear also that the resistance of the "hothouse plant," whether plant or animal, is lower than of those who live in less enervating conditions. Clearly, those who spend much of their time in overheated rooms do not thrive.

The bad effects of being too warm are due to (1) faulty distribution of blood, leaving vital organs less well supplied when much blood must go to the skin to be cooled; (2) lowering of the rate of metabolism; and (3) actual slight rise of body temperature in spite of lowered metabolism.



Thermometer showing optimum indoor temperature. All thermometers should be marked thus.

Too low a temperature indoors is equally harmful, but for many people coolness is more uncomfortable and therefore less likely to be endured for long. But there is a danger zone in the region of 65° F. for those sitting still and clad for 70° F. This temperature may not be cool enough either to attract attention to the need for voluntary action (adding more clothing and exercising the muscles) or to stimulate the body's automatic action to generate heat and restrict loss of heat.

It is thought that optimum temperature is as important a health objective as optimum diet.

Healthful Relative Humidity. The standards of the American Society of Heating and Ventilating Engineers permit a range between 30 and 60 per cent of saturation for indoor temperature. The former figure would perhaps be the most practical limit for homes and the latter for public places. Where many people gather the humidity tends to rise, owing to moisture given off from skin and lungs. In rooms occupied by only a few persons the air does not become moistened thus; on the contrary, in the heating season it may become overdried by artificial heat. Too much moisture in indoor air is uncomfortable; too little has a drying effect upon the skin and mucous membranes, which may harm them.

In winter, outdoor humidity will usually be low, and indoor humidity will correspond. In overheated houses, the humidity may be lower than in any habitable region. It will not reach 30 per cent except by artificial means. Yet research seems to show that most people feel as well, work as well, and keep as well with humidity at 20 per cent as at 30 per cent.

Without attempts to increase the moisture in the air but with care not to reduce it by overheating, indoor humidity in winter will average not far below 20 per cent, and this is considered satisfactory. If furnaces and radiators are supplied with large waterpans and these are kept filled, the margin of safety is increased.

It should be noted that natural humidity is satisfactory only if the temperature is kept in the neighborhood of 70° F.; if allowed to rise higher even for a few minutes the air will be dried and will remain so for some time, absorbing moisture from contents and occupants of the room.

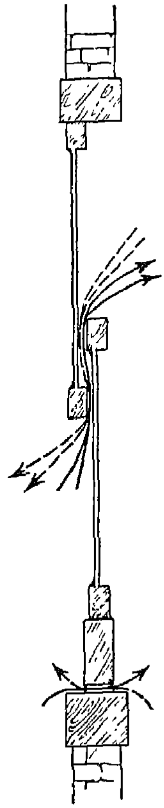
Air Motion Desirable. Air from outdoors enters a building in a given volume and at a given velocity, the latter measured in feet per second or per minute. The velocity of air as it enters a room depends, first, upon its velocity outdoors; second, upon the relative temperature indoors and out; and third, upon the size of the opening through which it is admitted. When outdoor air is very cold, the wind may "whistle" even through a small opening, although outdoor velocity is low. Indoors, a natural circulation of air takes place because hot air rises and cold air falls.

The significance of these facts combined is that much air may enter a house in winter even through small openings and may set up pronounced currents. In fact, so much air enters through natural spaces around windows and doors that it is scarcely necessary to open windows except to remove objectionable odors and smoke or excess heat. This is true even

when weather stripping, storm windows, and storm doors are used, and no fireplaces are present.

Recent findings indicate that natural air motion, like natural humidity, is satisfactory indoors provided that heating is correct. The rate should not be more than 15 to 20 feet per minute. Rough estimates may be made by the use of a candle flame; it will move, but barely move, when air motion is correct.

There would be no objection to a more rapid rate of air motion if it did not create drafts. A draft is a clearly perceptible current of cooler air. Drafts cause dangerous local lowering of body temperature, with perhaps general chilling. The feet and ankles are especially sensitive to drafts. Since cold air falls, the lower part of a room will be cooler than the upper. Therefore windows, if opened, should be opened from the top; or, if from the bottom, deflectors should be used. The temperature at 18 inches from the floor should be at least 65° F. All recent studies of indoor atmospheric conditions have placed less emphasis upon increasing air motion than upon preventing drafts.



Window, open, with window board at the bottom. Note that air enters where the two sashes overlap.

Purposes of Ventilation. The inflow of outdoor air through natural openings is called natural ventilation (*ventus,* wind). As stated, it usually supplies sufficient exchange of air and sufficient air motion under normal housing conditions, but there are conditions in which it may be inadequate.

Obviously, not enough natural ventilation will occur in a room if the amount of window and door space (hence inward seepage of air) is too small in proportion to (1) floor space and cubic contents of the room; (2) number of occupants; (3) amount of contamination of the air by odors, smoke, and fumes; and (4) amount of heat. The code of the Federal Housing Administration calls for rooms of given dimensions with openings of sufficient size to provide for natural ventilation under usual conditions of occupancy, and mortgages are not issued on houses not complying with the code.

When it is necessary to exchange indoor air for outdoor at a more

rapid rate than through natural openings, extra ventilation is accomplished either by (1) open windows, (2) ventilating fans inserted in windows or walls, or (3) mechanical systems of ventilation consisting of ducts through which fresh air is forced into a room (plenum system; *plenum*, full) or indoor air is drawn out (exhaust system or vacuum system; *vacuum*, empty).

Fans are useful in homes (e.g., in kitchens, to remove heat and odors), and they meet the needs in certain other conditions. In many industries and also in public gathering places, mechanical systems of ventilation are virtually essential. They are planned to function when windows are closed and do not operate otherwise.

The amount of carbon dioxide in the air is used sometimes as an index of ventilation, because this gas usually accumulates in inverse proportion to the amount of ventilation. The implication is not that the carbon dioxide itself is a danger; breathed and rebreathed air in any ordinary circumstances does not become harmfully low in oxygen or high in carbon dioxide.

What Does Complete Air Conditioning Accomplish? An apparatus for causing the indoor atmosphere to reach all known standards for health and comfort provides for the following: (1) heating, (2) cooling, (3) humidification, (4) dehumidification (especially important in summer), (5) purification, i.e., removal of foreign matter (either filtering air or washing it by passing it through water or spraying it with water), (6) ventilation, i.e., exchange of indoor air for outdoor, (7) deodorizing (usually accomplished by purification and ventilation, but by other means if necessary), (8) circulation (of the "manufactured" air, at the correct rate of motion).

Mechanical Air Conditioning and Disinfection. Mechanical systems are especially valuable in buildings where crowds gather and temperature and humidity are high. Under such conditions it is extremely difficult to keep the atmosphere satisfactory by the use of heating systems and windows only or even with additional ventilating devices. Complete systems are now in use in many theaters, stores, restaurants, large offices, and the like.

Difficulties have arisen in determining the degree to which cooling should take place in summer. The optimum temperature for an artificially cooled room on a hot day is not 70° F. but somewhere between that temperature and the outside temperature. A sliding scale is used, indoor temperature rising with outdoor temperature but at a slower

rate. Many authorities believe the scale needs revision to make less contrast between outdoor and indoor temperature. In the meantime, individuals entering an overcooled place on a hot day should, if lightly clad, leave it at once.

In certain industries, air conditioning has become invaluable in aiding the manufacturing process and limiting occupational hazards.

Air conditioning apparatus in homes is practical if the structure of the house is adapted to humidity higher than natural. Perhaps its major advantage is that of cooling and drying the air in summer.

In homes lacking apparatus for air conditioning, excellent results for the average well adult may be obtained during the heating season by observing one rule—never allow the thermometer to go much above 70° F. As has been mentioned, in a room kept at this temperature both humidity and air motion may be practically ignored.

By the use of ultraviolet rays and by chemicals and aerosols sprayed into the air, indoor air can be rendered relatively free of bacteria. These methods are in use at present in a limited way, chiefly experimental, but undoubtedly will come into wider use in certain conditions where the occupants need special protection from infection. Even now, ultraviolet rays are regularly in use in a few operating rooms and infant nurseries in hospitals.

8
Keeping Clean

According to an ancient proverb, "Cleanliness is next to godliness." A modern version runs, "If cleanliness is half a virtue, uncleanliness is a vice and a half." Certainly from the esthetic point of view this is true; it might be said that cleanliness is half of beauty, and uncleanliness is ugliness itself.

Since cleanliness generally is recognized and sought as essential to self-respect and to social acceptability, its sanitary values usually are obtained coincidentally. Nevertheless, some of these values may be missed unless they are objectives in themselves.

Cleanliness and several other matters pertaining to the skin and its appendages and to the mouth and the teeth will be discussed.

The Skin and Its Appendages

Under this heading are included bathing, the care of the complexion, the hands, and the hair, and certain communicable diseases of the skin.

Bathing

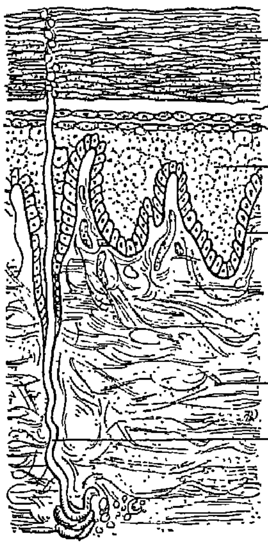
Is Daily Bathing Necessary? The skin is constantly secreting sebum and sweat, and if these accumulate upon the skin they quickly become an offense to the olfactory sense, more apparent to associates than to the offender. This in itself is a prime reason for daily bathing. Furthermore, these secretions, together with dead skin cells and dirt from the exterior, are somewhat irritating to the skin and form an excellent breeding place for bacteria. All this debris constitutes both a social and a sanitary hazard.

For some persons a daily bath is desirable for still other reasons, namely, for the physiologic effects of the temperature of the bath.

Bacteriologic Aspects of Bathing. First, a clean skin in itself has germicidal value. Bacteria find conditions for growth less favorable on a clean skin than on a dirty one. In one series of experiments, 90 to 95 per cent of the bacteria in a broth culture placed on a clean skin were killed in 10 minutes, but an equal number survived many hours on a skin that was dirty or greasy.

Second, soapy water flowing over the skin and off exerts a mechanical effect in removing bacteria from the skin.

Third, soap has a definitely antiseptic or germicidal effect; it lowers the vitality of some kinds of bacteria and even kills certain others. Its effectiveness is increased according to the amount used and is more pronounced in warm water than in cold and against some bacteria more than against others. All soaps are practically the same in these respects, and the choice should be made among pure soaps having high lathering properties and a low percentage of irritating free alkali.



The layers of skin, in microscopic section. The top three represent the scaly portion, while the stratum germinativum is the region of growth. The dermis contains nerves, blood vessels, and the sweat gland origins.

Physiologic Effects of Bathing. When water either warmer or colder than the body is used for bathing, the temperature-regulating mechanism is set into action to counteract its effects. Various changes in circulation and metabolism occur, in much the same way as when the surrounding medium is air; these were mentioned in Chapter 7. Points that must be considered in reference to baths are as follows:

Very hot baths (100° F. and over) draw much blood from the interior to the skin, which may cause dizziness or fainting. Also, they lower the rate of metabolism; on this account they are obviously of no use for the purpose they are commonly taken, that of reducing weight. Any weight lost after a hot bath is due to loss of water by perspiration and is regained as soon as fluid is taken. Because hot baths leave the skin hot and often moist from perspiration, they are particularly likely to be

followed by chilling. Hot baths are unsafe for many persons and unwise for most.

Hot baths or *warm baths,* not much above skin temperature, are useful for relaxation of muscles, for overcoming the effects of fatigue, for warming up when chilled, for refreshment between the activities of day and evening, and, taken before going to bed, for promoting sleep. Since they do dilate the skin capillaries slightly, there is some danger of chilling if one goes out into the cold immediately, unless the warm bath has been followed by a cold shower. Usually there is no danger if one dresses in a leisurely fashion and sits at rest half an hour after a warm bath before exposure to the cold.

Tepid baths, at skin temperature, when prolonged, appear to have a particularly soothing effect upon "nerves." They are utilized for this purpose in the treatment of nervous and mental diseases characterized by excitement.

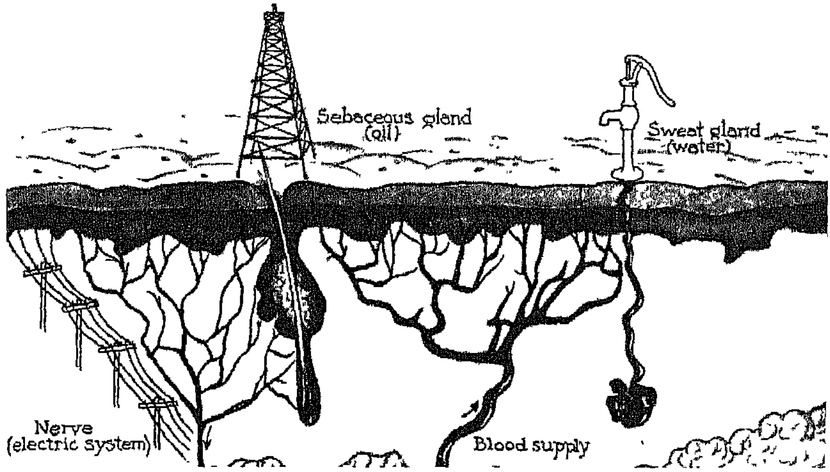
Cold baths are highly stimulating to circulation and metabolism. Their bracing effect is beneficial to those who react normally to them. The reaction should be an immediate glow of warmth throughout the body. Vigorous rubbing with a towel and brisk exercise help to produce it. If the reaction fails to appear, cold baths should be discontinued.

CLOTHING AND CLEAN SKIN. Clothing protects the skin against dirt from the exterior, but if it is not itself immaculate it quickly becomes a breeding place for bacteria and a bacteriologic as well as a social liability. For garments that are not washable in soap and water, dry cleaning is equally effective as a means of disinfection.

THE COMPLEXION

In general, the skin of the face requires much the same care as the skin of the rest of the body. Because it is uncovered and especially exposed to dirt and irritants, care must be taken to prevent any unnecessary soiling, and washing must be thorough and frequent. This is particularly necessary because the skin of the face has relatively large sebaceous gland ducts ("pores"), offering easy access to foreign material, including bacteria.

Soiling the Complexion. Many people unthinkingly and unnecessarily soil the face in the following ways: rubbing it or merely touching it with dirty hands or with hands in dirty gloves; wiping it with dirty handkerchiefs such as have been carried about in the pocket or handbag or used for other purposes; allowing coat collars, especially those of fur, to rub



Sweat and oil glands of the skin. (Courtesy, *Today's Health,* formerly *Hygeia.*)

against the cheeks; using dirty powder puffs (and a powder puff is dirty when it has been used once); using dirty face cloths or towels (not washed and dried since previous use); allowing the face to come into contact with soiled fabrics such as blankets and pillow covers; etc.

Avoiding Skin Irritants. Undue exposure to sunlight and to wind may have an irritating effect, especially upon a thin, dry skin. So also may extreme dry heat, as from hair dryers and open fires. Anything that greatly reddens the skin (i.e., dilates its capillaries) and makes it itch and burn may leave the susceptible skin permanently damaged. This is true of a single severe sunburn.

Any chemicals that cause reddening and discomfort should be avoided even though the irritation is slight, as from strong soap, lotions, or cosmetics. The oils in cold cream are irritant to some persons.

Cleansing the Face. For most persons the only satisfactory cleansing agent is warm water and soap. It should be used from once to several times a day, those with thin, dry skin requiring the minimum and those with oily skin and large pores the maximum. The freshly washed hands should be used rather than face cloths. The soap should form an abundant lather. After being washed, the face should be thoroughly rinsed with warm water, followed by cool. Extremes of temperature are safe only in special instances. Drying should be accomplished by patting rather than rubbing. Cleaning tissues are preferable to any but perfectly fresh towels.

Acne. The commonest blemishes of the complexion are associated with the sebaceous glands. These glands normally secrete an oily substance (sebum) which acts as "nature's cold cream" in keeping the skin pliable. If sebum moves outward through its ducts at a rate slower than normal, it tends to dry and collect as a plug, over which the skin cells grow, the result being a seedlike raised spot called a "whitehead." More commonly, the dilated mouth of the duct remains open, dirt collects in it, and a "blackhead" is the result. If infection starts in a duct, a "pimple" forms. It is a raised reddened area at first, but if pus forms in it (i.e., it "comes to a head") a yellowish-white, softer area appears at the apex. Some subside slowly without opening (i.e., "blind" pimple).

All these blemishes are evidence of faulty action of the sebaceous glands, or infection in them, or both. Many persons have them occasionally. During adolescence they frequently occur as a chronic disease called acne.

There is no specific treatment for acne. Nearly all dermatologists agree, however, that cleanliness through frequent, thorough but gentle use of soap and water is essential, although it may not be enough to cure it. Beyond washing, treatment varies according to the individual. In some cases, further local treatment is needed, either by application of medicines, by x-rays, or by ultraviolet rays. In other cases, various aspects of health must be improved (e.g., the state of nutrition or the condition of the digestive tract). Occasionally, acne appears to be a manifestation of allergy to particular foods (e.g., candy, chocolate, sweets, nuts, etc.). Since acne seldom appears before adolescence or lasts long after it, there is ground for believing that sex gland functions are in some way implicated, and in some cases endocrine treatment has been of assistance.

The home treatment of the lesions of acne should be cautious, because of the danger that infection will spread locally or, still worse, from the face to the veins of the brain. A red pimple should be left alone unless pus appears just beneath the surface, in which case the area may be sterilized with alcohol, the white spot pricked with a sterile needle, and the pus gently squeezed out, after which alcohol should again be applied. Seedlike whiteheads may be similarly treated. Blackheads if squeezed will usually return promptly, because the duct is permanently enlarged. Thorough cleanliness should keep them inconspicuous by limiting the amount of dirt that collects in them. Sometimes they spontaneously become less conspicuous after adolescence.

Are Cosmetics Harmful? Cold cream is useful to remove surface dirt before washing the face and, in the case of dry skin, to keep it soft. For the latter purpose, it should be applied when the face is clean, rubbed in gently, and left on all night. Creams said to possess magical properties in preventing wrinkles, "feeding" the skin, and the like have no greater virtue than simple inexpensive creams of standard composition.

Nongreasy foundation cream or vanishing cream, used by women under powder or rouge, may serve as slight protection of the skin from cosmetics and weather.

Powder is of two sorts. Most face powder for women is chiefly vegetable starches. A few face powders and all after-shaving powders for men are talc, a mineral. Starch granules swell when moist and become slightly sticky; therefore, face powder adheres more closely to the skin, but it may also plug the mouths of the sebaceous ducts if it enters them and swells there. It should not be used directly on the skin, especially when the skin is or is likely to be moist. Talcum powder is safer for the skin.

Rouge for the skin or the lips is ordinarily harmless. On the skin, it is better not to apply rouge directly to it but over a cream. Reputable manufacturers do not use harmful chemicals, but individuals may be susceptible even to pure cosmetics.

Substances to darken the eyelids, lashes, and brows must be used with great care, if at all, because of the danger of injuring the eyes.

Rules for the use of cosmetics are as follows:

1. Apply them only to a clean skin.
2. Use only clean applicators.
3. Use only products of reputable manufacturers.
4. Remove every trace of them at night.
5. Do not use them to disguise the need of more fundamental treatment of the skin.

The Hands

Hands cannot be entirely freed of bacteria. Laboratory studies show that colonies of 20 or more kinds of bacteria may grow on culture media from hands that have been washed according to the most exacting technic of surgeons preparing to operate (for which reason surgeons wear sterile rubber gloves).

Sanitary Requirements for the Hands. Accepting the fact that hands are never quite clean, one must avoid using them in such a way as to transfer bacteria from them to the body apertures, from one part of the

body to another part, or from other persons or objects to one's self. Of course, it is essential that the hands be kept as clean as possible; they should be washed not only when they look dirty, but also when they have been subjected to any possible bacterial contamination (as after toilet procedures) and when they are about to be used for handling food.

To approach a standard of bacteriologic cleanliness, warm soapsuds and a stiff nail brush must be used to scrub every square millimeter of skin, and minutes must be spent on the process. Rinsing is important for final cleansing and also to free the skin of soap. Drying is important in cold weather to prevent chapping. For those whose occupations require much hand-washing or exposure to irritants, the use of cold cream at night is desirable.

Care of the Nails. The space under the tip of the nail should be cleaned by an orange stick during the washing of the hands. The point of a nail file, if smooth, may be used after the hands are dried. Also, during the drying process, the orange stick or the towel should be used to press back the cuticle which grows at the base and side of the nail. Hangnails should not occur if the nails are cared for as described, but if they do occur they should always be cut and never pulled.

If polish is used on the nails, care should be taken not to allow it to adhere to the cuticle and thereby to pull it outward as the nail grows. This is a common cause of hangnails. Nail polish should be renewed frequently, allowing the nails to remain uncovered overnight.

To shorten the nails, a file should be used in such a way that the strongest strokes are from the corner toward the center of the nail. Any remaining fringes may be removed by an emery board.

Home manicuring is safer from the sanitary point of view than commercial manicuring and can be esthetically as satisfactory if the nails are given a few minutes' care every day.

The Hair

Why Should the Hair Be Brushed? The hair shaft is composed of dead cells containing a horny substance. It sheds dirt readily upon brushing. Daily washing of the hair is usually neither necessary nor desirable, since vigorous brushing serves sanitary purposes for one to three weeks at a time, except in the case of those who have especially active oil glands or who are especially exposed to soiling from the exterior.

To be at all effective, however, brushing must be done with a brush having stiff bristles that reach through to the scalp. Although such a

brush is expensive it is virtually a necessity for all but those with the sparsest hair.

In addition to cleaning hair and scalp, brushing serves to stimulate circulation through the scalp and thereby favors normal action of sebaceous glands.

Shampooing. Five rules for shampooing are: (1) use plenty of water, neither too hot nor too cold; (2) use plenty of soap that lathers well; (3) wash the scalp itself as thoroughly as the hair, rubbing it with the finger tips; (4) rinse the hair thoroughly, at least twice, until it squeaks when the hands are rubbed over it (if it still feels smooth, it needs more rinsing); (5) dry the scalp and the hair thoroughly, neither too rapidly nor too slowly.

Towels may be used throughout the drying process; or, after the excess moisture is removed by towels, the process may be completed by exposure to sunlight and a breeze or to moderate artificial heat. The hair should, of course, be completely dried before one goes outdoors in cool weather.

For dry hair, olive oil may be applied to the scalp the night before the shampoo.

Causes of Falling Hair. Old hairs are constantly being shed and new ones growing. A hair grows from its root deep in the skin and is nourished from blood vessels near by. In certain conditions of ill health the nutrition of the hair is not adequate, and shedding is greater than regrowth. When health returns, hair regrows provided the roots retain their vitality.

The male sex is susceptible to baldness, a trait which is apparently hereditary and sex-linked (i.e., appears in only one sex, in this case the male). Nothing whatever can be done to prevent it or check it, although millions are spent annually in that futile effort. Other scalp abnormalities may coexist, however, and be subject to treatment.

Care of the Scalp: DANDRUFF. Dandruff is a bacterial disease of the sebaceous glands of the scalp, thought to be communicable through articles (brushes, combs, hats, etc.) used in common with the infected. It occurs in two forms: in one form an excess of sebum collects on the scalp as a greasy deposit, in the other form, as layers of dry scales which cause itching and are shed abundantly. So-called oily hair or dry hair is often related to one or the other form of dandruff. No amateur methods of treating dandruff will do more than remove for the time being the grease or the scales. A physician should be consulted regarding the

diagnosis and treatment. Dandruff should be cured for its own sake and because it is sometimes the cause of falling hair and poor complexion. Cure often is not difficult.

Hair Tonics. Nothing applied to the scalp will nourish hair except indirectly through stimulating the scalp circulation. Most so-called hair tonics are alcoholic solutions which dissolve excess sebum and scales, make the scalp more comfortable, and perhaps improve the appearance of the hair. The massage with which they are applied may be helpful. However, if medication is thought to be needed, it should be obtained through a physician's prescription for one's personal condition.

Hair Waving. In cross section, a straight hair is nearly round, whereas a wavy or curly one is elliptical. A combination of mechanical methods (stretching and winding) with chemicals to soften the hair and heat to "cook" it will cause a straight hair to become elliptical and wavy and to remain so until it is shed or cut off. Such methods of permanent waving do not improve the quality of the hair. For example, they often dry it, destroy its luster and "life," and slightly discolor it. But if skilfully done, the total effect may be an improvement in the appearance. In any case, it is a question almost entirely of appearance, for usually the health of the scalp and the future growth of hair are not affected.

Finger waving makes use of a lotion, usually with a quince seed base, to soften the hair and of heat to "set" it. The main danger is not to the hair or the scalp, but to the skin of the face and also to the ears. Only moderate heat should be used for drying. The current of heat should not fall upon the face, the ears should be fully covered, and the canals plugged with cotton.

Communicable Skin Diseases

Ringworm. This common disease is due to fungi of several different sorts. Ringworm of the body (groin, armpits, etc.) causes a reddish, sharply outlined eruption. It is usually acquired through wearing clothing previously worn by an infected person. It would not be difficult to cure it usually if it were not for the fact that the fungi may remain in the clothing and reinfect. Long boiling is required to kill the fungi.

On the foot, ringworm is called "athlete's foot" because it is frequently acquired from the floors of shower baths in gymnasiums and training houses. The fungi are deposited on the floor by the infected and survive because of the moisture there. All floors walked upon by the infected are likely to be contaminated. If one person in a household group has

athlete's foot, all are likely to have it if they go about barefoot on the same floors. Prevention of athlete's foot is by footgear and by various disinfectant solutions used on floors subject to contamination and by footbaths for users of swimming pools. Treatment of ringworm, although laborious, usually is successful except in the case of the nails.

Impetigo. This common disease is always acquired from someone who has it or from something touched by that person. It begins as small "pimples" which soon run together and form crusts. Usually it responds well to treatment and usually is not serious unless located near the eyes.

So much recent investigation has been made on skin diseases that very successful treatments are available for impetigo and the preceding ringworm fungi. No person should suffer from the temporary disfigurement, irritation, or danger of spreading these diseases to others, but should consult a physician for diagnosis and cure.

Scabies. Scabies is an infestation by an animal parasite known as the itch mite. The first symptom usually is itching between the fingers. The whole body must receive treatment according to a special technic, or the disease persists indefinitely and is passed on to others.

The Teeth and the Mouth

The teeth are included in this chapter because they are the object of daily cleansing procedures. Since their physiologic importance is that of aiding digestion, they might well have been discussed in Chapter 4.

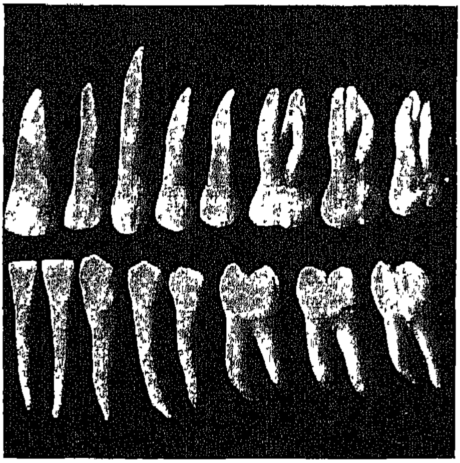
Aside from being an advantage to health, a clean mouth and sound teeth have esthetic and social advantages which most people fully appreciate. Yet dental defects are among the most common of all defects or minor pathologic conditions in man. The rate among selectees is shown on p. 9.

The Causes of Caries. It is believed that heredity has an important role in determining the potential soundness of teeth, and that a second important factor is the diet of the infant and child up to the time when all the teeth are fully developed. The developing teeth must receive a due supply of minerals (chiefly calcium and phosphorus) that give teeth their hardness. Also, they must receive the benefit of certain vitamins and endocrine hormones to facilitate the process of tooth formation. It appears that sound, well-formed teeth are much less subject to caries (decay) than defective ones.

Local causes are responsible for initiating the process of caries. Bacteria present in the mouth act upon carbohydrate food particles or dis-

solved sugars so as to produce acid which weakens the enamel of the teeth and eventually produces a cavity.

The Results of Caries. If unchecked, caries progressively involves the solid portions of a tooth, finally extending to the pulp in its center, which consists of nerves and blood vessels giving life to the tooth. When exposed, the pulp usually becomes infected, and the tooth dies. Infection may spread from the abscess at the apex of the tooth to the glands of the neck or elsewhere, and toxins may enter the blood and spread



Teeth of adult, labial and buccal surfaces.

throughout the body. Some authorities believe that infected teeth are often the foci of infection from which joint troubles and other ailments arise.

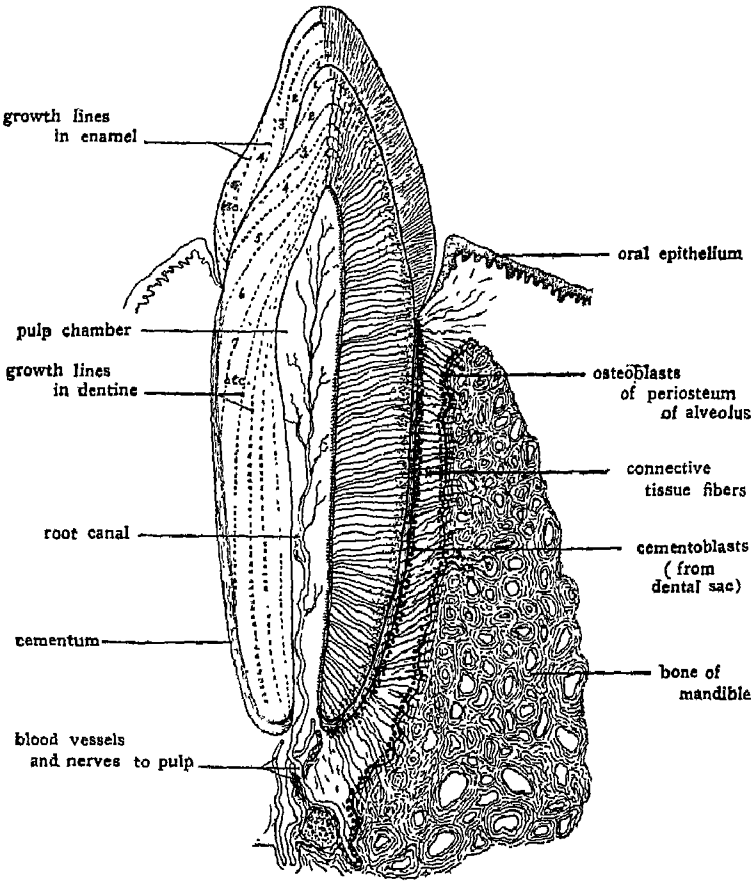
How to Protect the Teeth. Although early in life much may be done to make the teeth sound through correct diet, after the teeth are fully formed it is doubtful whether a deficient diet harms good teeth or an optimal diet helps poor ones, since their metabolism is not active as in other tissues of the body.

At all times in life it is recommended that teeth be kept clean in order to minimize the food debris in which acid-producing bacteria thrive. Sugary and starchy foods in particular should not be allowed to remain long in contact with the teeth. Certain acids, such as those in hard candy, appear to cause decay if the teeth are not cleaned soon after taking them. Cleanliness, however, cannot be relied upon to prevent decay.

It has been determined recently that fluorine protects the teeth of growing children.

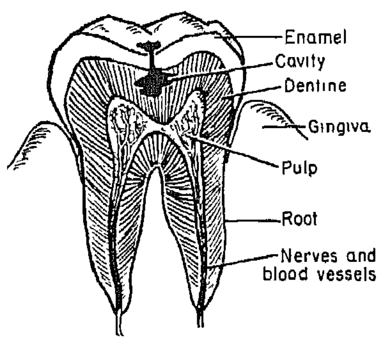
For its direct application the surfaces of the teeth are cleaned and dried. A 2 per cent solution of sodium fluoride is then applied to the surfaces and allowed to dry in the air for three minutes. Four applications are recommended at 3, 7, 10, and 13 years of age to protect the deciduous teeth and the permanent teeth as they appear.

Fluorides in controlled amounts are now being added to water supplies in some localities as in Wisconsin, to supply the amounts necessary for the prevention of caries. The presence of 1.0 to 1.5 parts per million of fluoride in drinking water is associated with a 50 to 65 per cent reduction in caries. Higher concentrations produce mottled tooth enamel,



Schematic diagram showing the topography of a tooth and its relations to the bone of the jaw. The numbered zones indicate empirically the sequence of deposition of the dentine and enamel. The so-called growth lines in the dentine and enamel follow the general contours indicated by the dotted lines in the figure but are much more numerous.

severity increasing until at 6.0 parts per million, mottling is practically 100 per cent. Controlled fluoridation has been sufficiently investigated by the medical profession so that the American Water Works Association in 1939 gave official acceptance of the practice.



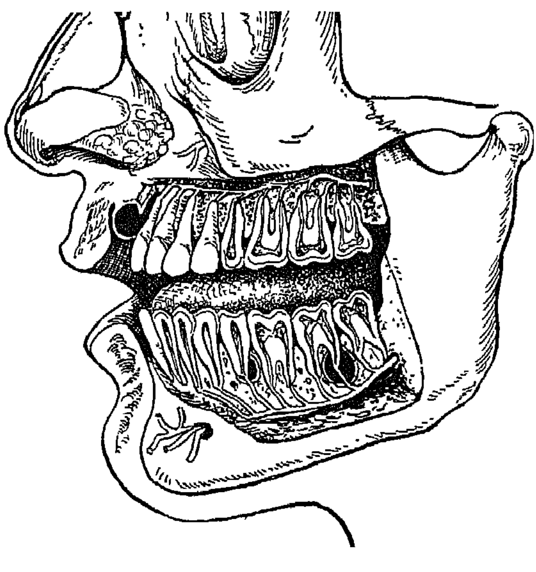
Tooth (molar) showing cavity more extensive in dentine than in enamel.

The one measure that dentists universally agree is effective in saving the teeth is to have them regularly inspected, so that any area of decay can be detected when it is superficial, cut out from the tooth, and replaced by a filling.

Mechanical injury of teeth, as by biting hard objects, should be avoided, and a dentist should be consulted at once if it occurs.

Why Is Good Occlusion Beneficial? The teeth should meet each other in a normal "bite" or they do not serve their proper purpose in chewing. Also, teeth that are not used for chewing are likely to become loose and the gums around them to be unhealthy.

A poor occlusion results from inheritance of narrow jaws, thumb-



Sectional view of the mouth showing typical sac-like abscesses of teeth.

sucking in infancy, and mouth breathing in childhood, as in the case of adenoids. In adult life a normal occlusion may be lost as a result of extraction of teeth, which allows the others to drift out of position. Finally, it may result from fillings poorly placed so as to cause high spots which keep the teeth from interlocking normally.

If malocclusion is not prevented from occurring in childhood, it should be treated by orthodontic means ("straightening") at an early age. After adolescence, a complete correction may be impossible. At any age, if a permanent tooth must be extracted, the gap should be filled by an artificial tooth or "bridge."

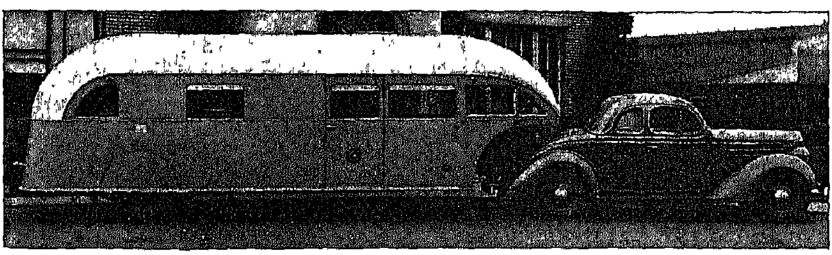
How Should the Teeth Be Cleaned? After each meal and at night every trace of film should be removed by means of a brush, water, and a dentifrice containing a mild but not gritty polishing agent. One's dentist should be asked to name a suitable dentifrice and also to demonstrate the method of using the brush. In order to have a firm, resilient brush always available, it is desirable to use two or three in rotation, giving each a chance to dry before being used again.

Dental floss should be used very gently between the teeth if necessary to remove debris not reached by the brush.

Periodically, the teeth should receive professional cleaning by a dentist or a dental hygienist employed by a dentist. Tartar often accumulates behind the lower front teeth and outside the upper side teeth where the salivary ducts open. It consists of solids from the saliva, together with food debris. When deposited it is soft and does not harden for 12 hours; it does not accumulate, therefore, if teeth are thoroughly brushed at intervals of less than 12 hours.

Care of the Gums. Inflammation of gums (gingivitis) occurs as a result of mechanical causes, faulty diet, or infection.

The mechanical causes are malocclusion from any of the causes men-



A completely equipped dental trailer, manned by a dental officer and an attendant-chauffeur, carries dental aid to lighthouse and life-saving personnel located at isolated stations. (Courtesy, U.S. Public Health Service.)

tioned, poor technic in using toothbrush or dental floss, and the accumulations of tartar at the gum line. Preventive measures are obvious.

Diet affects the gums in two ways. First, vitamin C is highly important to the health of the gums. Second, the diet must be such as to require chewing, in order to promote circulation in the gums.

Infection occurs readily in unhealthy gums. Pyorrhea, a disease of the bony sockets of the teeth, with infection by pus germs, is often a late result of previous injury to the gums by mechanical or nutritional causes.

One infection of the gums, called "trench mouth" or Vincent's infection, may appear in gums that have previously been healthy. It is acquired from others who have it, either by means of direct mouth contact or through articles used in common. Occasionally it also involves the throat and is a serious, even fatal, condition. Ordinarily it merely causes rather inconspicuous redness with perhaps slight bleeding of the gums; but it causes an exceptionally foul odor of the breath, more offensive than that due to uncleanliness alone. The presence of this disease should be suspected whenever the gums become reddened, even in a small area. Ordinarily it responds well to expert dental treatment and to correct diet.

9

Avoiding Injury by Germs

Infection

The agents of infection are microscopic organisms that are pathogenic (*path,* disease; *gen,* producing). Many of them are bacteria, and all are loosely called by that name or by the name germs or microbes. With the possible exception of viruses, they are single living cells that carry on their lives much as do the larger organisms, that is, they breathe, feed, excrete, and reproduce.

While carrying on their life processes in human beings, germs interact chemically with the tissues upon which they live, and this results in the production of toxins which are harmful to the body.

Because germs nourish themselves at man's expense, they are called parasites (*para,* near; *sitos,* food). The human being who is harboring them is called their host.

Local Damage by Germs. Many kinds of germs cause inflammation, the characteristic features of which are redness, pain, swelling, and heat. Often the outcome is an exudate, a whitish-yellow, semifluid material known as pus. This occurs, for example, in many infections of the nose (late stage of a cold), ears, eyes ("pink eye," etc.), and appendix.

Some germs produce other local lesions (e.g., the chancre of syphilis). Others do little or no harm where they enter the body but produce their typical lesion in the tissues to which they travel (e.g., the tubercle of tuberculosis).

How Are Infections Named? An infection is named according to the germs that cause it, according to the lesion produced, or according to the location in the body. In some cases all three factors appear in the name of an infection. For example, a streptococcus pharyngitis is an inflammation (*-itis*) of the pharynx (throat) caused by streptococci.

The term appendicitis, however, simply means inflammation of the appendix, without reference to the kind of germs. The term tuberculosis means an illness characterized by tubercles produced by the tubercle bacillus.

What Are the Specific Infectious Diseases? Like tubercle bacilli, many kinds of germs always produce a general systemic disease with certain typical lesions in particular tissues and a set of typical symptoms. A characteristic of these specific diseases is that they are communicable as such from person to person. To stress that fact and the danger involved in exposure to them, they are commonly referred to as the specific communicable diseases.

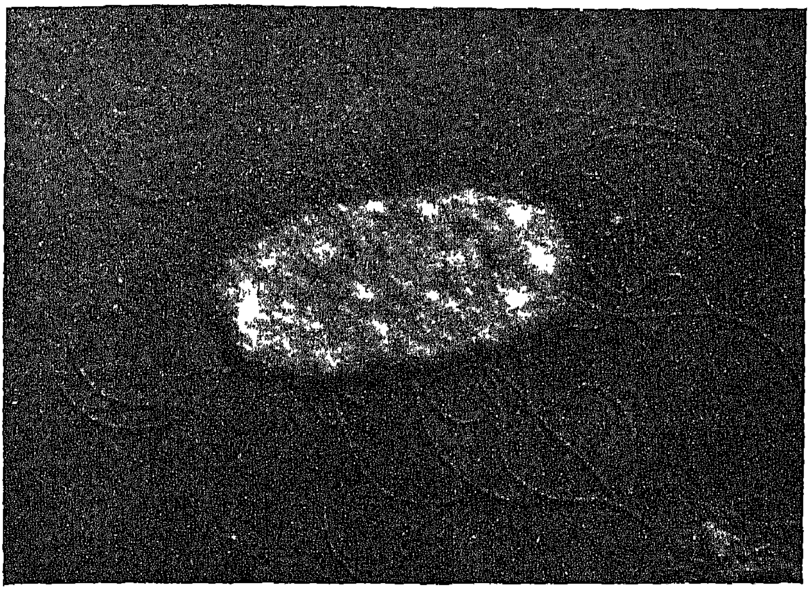
However, the germs from any infection are communicable, although they may not cause precisely the same disease in others. For example, the germs from a boil (pus germs) may cause a similar lesion in another person if they come into contact with the skin, they may cause conjunctivitis or more serious infection if they enter the eye, or from any location where they are received they may enter the blood and cause blood poisoning.

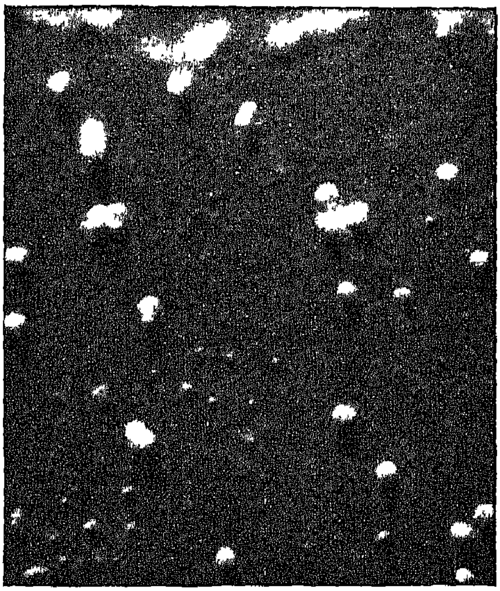
How Infection Spreads Within the Body. Germs or their toxins travel away from their point of entrance by progressive extension along tissues; they enter the blood vessels, causing "blood poisoning" (septicemia, bacteremia, or toxemia) of varying degree and perhaps causing new lesions elsewhere; or they enter the lymph vessels, in which case they infect the vessels (lymphangitis) and their associated lymph nodes (adenitis, such as often occurs as "swollen glands" in the neck). Infection remote from the original site may be of equal or even greater severity.

Acquiring Infection. Germs from the outside world (objects and persons) begin to enter the body shortly after birth. Many of the germs acquired day by day remain as resident germs, permanently domiciled in the skin, mouth, nose, and intestinal tract. Ordinarily these do not cause infection but they may do so under certain conditions (e.g., skin germs may start an infection in a cut; intestinal germs may infect the appendix, gallbladder, etc.).

Germs newly acquired from other persons are responsible for the majority of infections. The other person may be well and merely a carrier of the germs; or he may be ill with the disease, just about to be ill with it, or just recovering from it.

Although by far the largest percentage of infections in humans comes from other humans, a small percentage may come from infected animals





Two electronic micrographs fıom Wyckoff. (*Top*) A typical proteus bacillus with its many coarse flagella. (*Bottom*) Elementary bodıes from ultracentrifugally purified suspension of PR-8 strain of A-type influenza virus from chick allantoic fluid. The large spheres are virus particles. (Courtesy, Wyckoff: "Electron Microscopy," New York, Interscience Publishers.)

The spots on this plate of agar are colonies of germs which grew on it after water in which lettuce had been washed was sprinkled over it If the lettuce had not been washed these germs would have been taken into the body with the lettuce. (Courtesy, Broadhurst: "Home and Community Hygiene," Philadelphia, J. B. Lippincott Co.)

(e.g., rabies, especially from dogs; one type of tuberculosis from cattle; etc.).

The method by which germs are transferred may be direct person-to-person contact (as in kissing); or semidirect (as when droplets are sprayed from the mouth of one person into the mouth or nose of another); or indirect, through contact with some substance (vehicle) which has been contaminated by the germs or some living creature (vector) that carries germs on or within itself.

Some Important Vehicles of Infection: Water. Throughout history much illness has been caused by contamination of drinking water with germs from the intestinal tract of man. Modern public methods of water purification and sewage disposal have banished cholera from this country and reduced typhoid fever to a low point. Water-borne infections are now practically limited to rural districts with private and imperfect sanitation.

Milk. Germs may not only live in milk but multiply in it. If it becomes contaminated from the cow or from human beings who have

A violent, unstifled sneeze not quite complete. (Courtesy, M. W. Jennison.)

handled it, it is certain to contain large numbers of germs. Among the diseases often transmitted by milk and that may occur as milk-borne epidemics are typhoid fever, septic sore throat, diphtheria, and scarlet fever. Tuberculosis of cattle may be transferred to man through milk, but this is not common today, owing to modern standards for dairy cattle.

The fundamental requirements for milk are that it should come only from healthy cattle (free from tuberculosis and other infections and meticulously cared for in clean barns) and be handled only in a clean dairy by well persons using clean utensils. Even the most careful methods, however, must be supplemented by pasteurization (keeping it at 145° F. for 30 minutes). Milk pasteurized in the bottle is thereby made safe and, if completely capped and kept not above 50° F. while in transit, on sale, and in homes, will remain so for several days.

FOOD. It is a matter of public health to have all food produced under conditions that keep it free from germs until it arrives in the home. Regulations exist regarding foods that are transported from state to state in interstate commerce. The Food, Drug and Cosmetic Act of 1938 and the Federal Trade Commission are important means of protecting the public from foods that would be injurious to health.

In general, it is probably true that food infections arise more frequently as a result of faulty methods of handling, storing, and preparing foods in eating places and homes than at earlier stages in food production.

SOIL. Harmful germs of several sorts are deposited in the soil in the excreta of man or animals (e.g., the tetanus bacillus, which lives as an inert spore in the soil). As a rule, when these organisms infect man they have entered through the skin, especially through dirty wounds.

FOMITES. This term is applied to articles used or handled by an infected person. Among them may be mentioned toilet articles, bathroom fittings, doorknobs, eating utensils, bed clothing, personal clothing, including handkerchiefs and gloves, personal belongings such as pencils and books, and any furniture, furnishings, and fixtures upon which germs could fall or be deposited. In the case of dry objects, there is little danger unless the interval is short between its handling by the sick person and its rehandling by another. Moist objects may remain infected longer.

AIR. The air is important as a vehicle of infection indoors, especially in the immediate vicinity of a person who is expelling germs from the nose and mouth. In the air, germs may travel beyond the range of droplets if they settle on particles of dust which act as floaters for them, keeping them suspended in the air and ready to be breathed in by others. As many as 2,100,000 germs have been found in a single gram of house dust. Recent research indicates that purification of indoor air by ultraviolet rays or by aerosols may in the future become as important as purification of water is today.

Some Important Vectors of Disease. The rodents (rats and mice) are among the most important vectors. Rats are the intermediate host of the germs of plague, endemic typhus fever, and various other diseases which are transmitted to man by rat fleas. Other rodents also may carry disease. Even the domestic mouse may be responsible for certain intestinal infections such as are often called "ptomaine poisoning" and for one form of meningitis.

Among the insect-borne diseases, the chief in this country is malaria, carried by the female anopheles mosquito. Another mosquito in other lands carries yellow fever.

The domestic fly carries germs by the million on the feet and in the intestinal tract. It transfers infection if it has access first to germ-laden material (e.g., excreta) and later to food or objects that reach the mouth. In the past, the fly was often the vector of typhoid fever. In rural districts this may still be the case.

Lice, transferred from person to person, are vectors of epidemic typhus fever, trench fever and relapsing fever, which always occur in armies at war, and perhaps of still other infections, including syphilis.

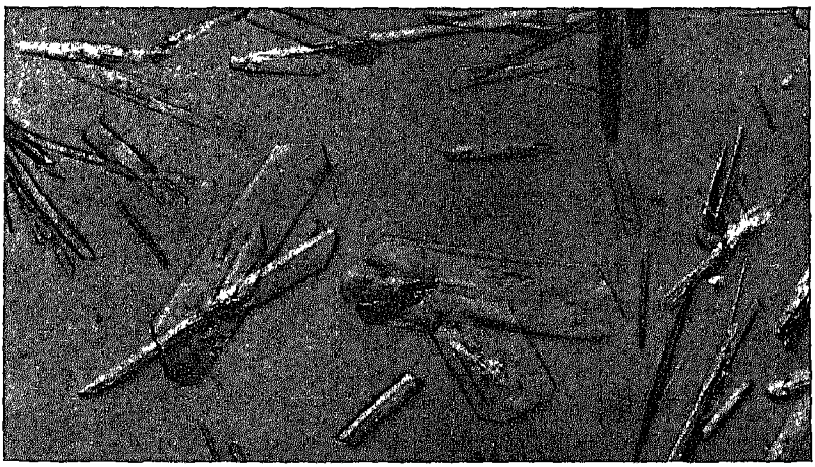
Destruction of Germs

Two aims govern much health work: (1) the destruction of as many as possible of whatever pathogenic germs are present in substances in the environment; and (2) the removal, destruction, or checking of growth of pathogenic germs wherever they are present on or in the body.

Germ Destruction in the Environment. Germs multiply rapidly as long as conditions are favorable for them. Those that are pathogenic to man thrive in the warmth and moisture of the body but do not as a rule live long apart from living bodies. Drying and extreme heat are especially likely to be fatal to them. Those on surfaces are killed by sunlight.

Disinfection of germ-laden materials (i e., ridding them of germs) may be accomplished by the use of heat (boiling, baking, or steaming under pressure) or by chemicals (such as chloride of lime, bichloride of mercury, carbolic acid, formaldehyde, alcohol, etc.).

By public measures of sanitation the number of germs at large in a community may be greatly reduced. Such measures include purification of water, proper disposal of sewage, protection of food and of milk, pasteurization of milk, drainage of swamps where malarial mosquitoes breed, etc. These and other methods of public sanitation are of value in that they destroy germs at their source or at some stage of



Crystal of sodium salt of penicillin-G. MacPhillamy and Wintersteiner. (Courtesy, The Squibb Institute.)

their journey from person to person or interfere with their transfer.

Germ Destruction in the Body. On the surface of the body disinfectants will kill germs, but many of them will also destroy tissues. Among the few that may be safely used, tincture of iodine has long ranked high.

On mucous surfaces, few disinfectants are safe for tissues unless diluted to such an extent that they act only as an antiseptic (a substance that checks growth of germs but does not kill them). Because of the delicacy of the mucous membranes no medicines should be used on them (e.g., for an eyewash, gargle, or douche) without medical advice.

Within the body, germs of some sorts may be killed by medicines. Among the medicines that have specific power to check infections are: quinine, quinacrine hydrochloride, and certain other drugs, in malaria; arsenic, bismuth, and mercury compounds, in syphilis; the sulfa drugs, penicillin, and streptomycin, all effective against a large number of infections.

Face mask. (Courtesy, Red Star Nursery Products.)

Asepsis

Is Asepsis Possible? The term asepsis implies freedom from germs (*a*, without; *sepsis*, poison or germs). A state of asepsis is possible in limited circumstances. For example, many phases of surgical operations and childbirth can be conducted aseptically.

Obviously, it is not possible in all conditions to render the bodies of human beings or the total environment, animate and inanimate, free of germs. Yet asepsis should be sought as an ideal in all possible circumstances. It is particularly important for individuals in their daily lives to use measures that will minimize the transfer of germs to and from persons, vehicles, and vectors. These measures may be called an aseptic technic.

Aseptic Technics. By personal measures the entry of germs into the body may be prevented or minimized. The following are important points to be observed in aiming for asepsis.

1. Avoid direct contact with the infected or carriers.
2. Avoid taking droplets into the mouth or nose from the mouth or nose of others.
3. Avoid unnecessary contact with any germ-laden secretions or excretions (one's own and others).
4. Avoid unnecessarily touching objects recently touched or objects in any way soiled by the infected. This rule includes especially
   a. Toilet articles or other easily contaminated articles.
   b. Soda fountain glasses or dishes in public places, unless they have been washed properly in scalding soap suds.
   c. Clothing worn by others.
   d. Pets that have been in a sickroom.
5. Keep the hands as clean as frequent, thorough washing and scrubbing in soap suds will make them.
6. Keep even the recently washed hands away from unnecessary contact with the skin or the body openings.
7. Keep even the recently washed hands away from unnecessary contact with food.
8. Keep the skin whole and clean and have injuries of the skin promptly treated.
9. Wear only clean clothing next to the skin.
10. Avoid suspicious water and food and unpasteurized milk.
11. Put nothing into the mouth that does not belong there.
12. Keep the living quarters free from dust and dirt, insects, rats, mice, and vermin.

Resistance to Infection

When germs are received upon or into the body, the outcome is not necessarily the same in all persons or in the same person at all times and in all circumstances. The difference is partly in the character of the microbial attack and partly in the degree of resistance the body is able to offer. The relationship between these two factors is shown on p. 205.

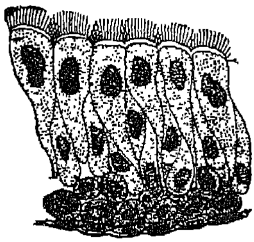
General Defense

The body is built and organized so as to present a certain amount of resistance to the germs to which it is potentially vulnerable. Scarcely any germs gain a victory unopposed. Every day in every person millions of germs are overcome before doing the slightest harm.

There are mechanisms (1) for repelling germs at their usual portals

of entry—the skin and the body apertures lined with mucous membrane (e.g., the nose and throat); (2) for localizing them if they do enter and destroying them there; and (3) for attacking them elsewhere in the body if they do spread in spite of localizing efforts.

Mechanisms of the "First Line of Defense." First, the skin is a mechanical barrier protecting the interior of the body. It is so constructed, with many layers of dead epithelial cells over the surface, that germs cannot pass through it as long as it remains normal and unbroken.



Ciliated epithelium. (After Stirling.)

Second, the mucous membranes, if normal, offer resistance of several mechanical sorts. These membranes secrete and are covered with mucus which is just sticky enough to entrap and hold germs like flies on flypaper and prevent their traveling farther inward along the body passages. Furthermore, this mucus has a flowing motion, tending to carry germs outward from the body. The amount of mucus is increased when foreign material is present on the membranes, which makes it still more effective in washing germs away. Also mucous cells possess cilia (processes like the pile on velvet) which wave continually, sweeping away excess mucus and germs. Finally, the presence of foreign material and of an increased amount of mucus excites the reflex acts of coughing and sneezing, which tend to loosen and expel germs from throat or nose.

Localization Mechanisms. The foregoing mechanisms are often but not always successful in preventing germs from gaining a foothold. If germs do infect, a process begins which tends to keep the infection local. Capillary blood vessels in the infected area become dilated, and plasma and white blood cells pass through their walls, massing in and around the area. Fluid and fibrin from the plasma, together with a quantity of white blood cells, form a wall around it. Even a fairly severe infection (e.g., a boil) may remain entirely local as a result of this "walling off" process.

In addition to the foregoing mechanical process, another process occurs—the germ-destroying chemicophysical process of phagocytosis.

Phagocytes and Phagocytosis. Some of the body cells are known as phagocytes (*phag*, devour; *cyte*, cell) because they are able to act upon germs in such a way as to destroy them.

The phagocytic cells are (1) *leukocytes* (white blood cells) and (2)

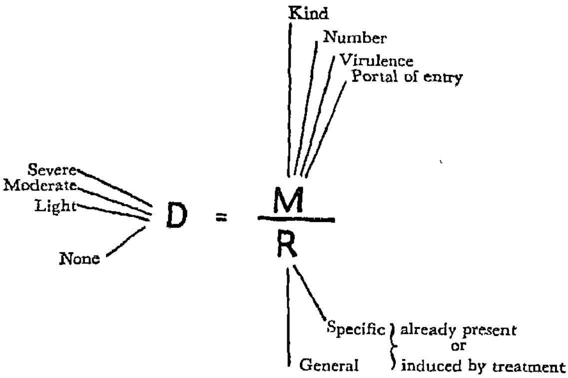
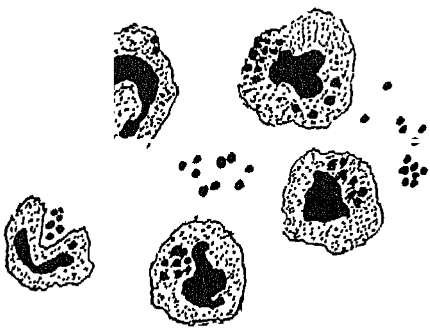


Diagram to show that disease (D), is the product of microbial attack (M), divided by resistance (R).

certain cells called *histiocytes* (*hist,* tissue; *cyte,* cell). Some of the latter are fixed cells, located in many tissues of the body, and some are wandering cells (monocytes) traveling in the blood.

Phagocytes that gather at an infected area carry on a chemical combat with the germs. The germs produce toxins which are harmful to the



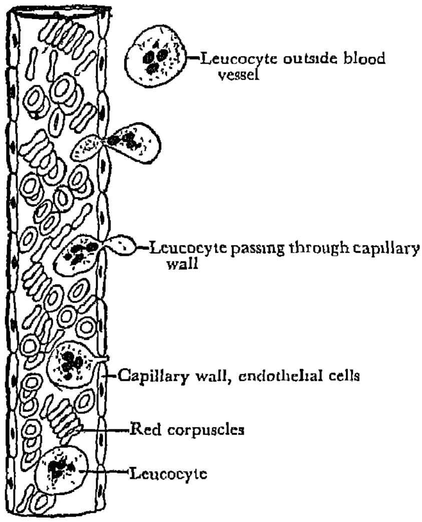
Leukocytes engaged in the process of phagocytosis.

tissues and to the phagocytes. The phagocytes produce a protein-digesting enzyme (protease) which is harmful to germs; also, they are able to change their shape so as to engulf germs and then to digest them.

A considerable amount of debris may be formed locally during infection by certain bacteria (pyogens). It consists of the bodies of bacteria, some dead and some still living, phagocytes, destroyed tissue, fluids from the blood, and secretions from the tissues. This is the pus characteristic of inflammation, but not of all infection.

After a combat of variable duration, either the phagocytes or the germs win. If the phagocytes win, infection subsides and reparative processes heal the area.

Factors Limiting the Wide Spread of Infection. If germs are not completely walled off and destroyed locally and travel to nearby areas, phagocytosis continues and may be effective in localizing it there (e.g., appendicitis may remain in the appendix or may spread to the neighboring peritoneum and be stopped there before it infects the entire peritoneum).



Diapedesis.

When germs escape from a local area they often enter lymph vessels and are caught in the first lymph node they reach. The lymph nodes contain many phagocytic cells; they might be called miniature incinerators except that they destroy by chemical action rather than by heat. Sometimes the first lymph node is not capable of conquering the germs and itself becomes a center of inflammatory reactions (e.g. enlarged glands in the neck from a sore throat or an abscessed tooth); yet if germs travel onward, they may still be intercepted and destroyed at the next set of lymph nodes.

Germs are still subject to phagocytic attack even after they enter the blood stream; there is still a chance that phagocytosis will be effective in preventing them from localizing themselves anywhere else, by overcoming them in the blood.

General Resistance. All the foregoing mechanisms of defense become

automatically more active when stimulated by the presence of germs, and this general activation must be looked upon as a general response of the body as a whole against germs in general.

General resistance may be defined as any general state of the body which tends to make it more competent to perform the functions necessary to overcome microbial invasion.

Nevertheless, valuable as general resistance is, it is not enough by itself to prevail against certain types of germs which will infect unless the body has specific resistance against them.

Specific Immunity

Specific Resistance or Immunity. When germs or their toxins enter the system, they affect the body chemically in such a way that it produces new chemical substances capable of destroying the germs and neutralizing the toxins. If these substances are produced in sufficient amounts, the person becomes immune to the germs that excited their formation. He recovers from the illness and may remain immune to the same kind of germs for a long time or even for the rest of his life.

Germs or toxins, when affecting body cells as described, are called antigens, and the new chemical substances produced by the body are called antibodies, which means chemical bodies that work against a specific infection. (Those produced in response to bacterial toxins alone are called antitoxins.)

Establishing Immunity. When a person is immune to a specific disease it is always because he has antibodies against it in his blood. There are six ways in which he may have acquired these antibodies.

He may have formed them during an attack of infection by the specific germs, as described above. They (or a biochemical condition having the same effect) may be a part of his hereditary make-up. He may have received them congenitally (i.e., before birth) from the mother's blood or during infancy from the mother's milk. He may have had a subclinical infection—one that gave no symptoms but did excite formation of antibodies. He may have developed his antibodies as a result of antigens made in laboratories and given to him by inoculation for that express purpose; these are known as vaccines. Or, finally, he may have obtained ready-made antibodies from outside sources by inoculation of serum containing them.

The possibilities of immunity in each of these six ways will be mentioned, in order.

DISEASES WHOSE ATTACKS CONFER IMMUNITY. One attack of the diseases listed below confers immunity for some time and sometimes permanently:

Chickenpox	Psittacosis
Diphtheria	Rocky Mountain spotted fever
German measles	Scarlet fever
Infantile paralysis	Smallpox
Measles	Tularemia
Meningitis (meningococcus)	Typhoid fever
Mumps	Typhus fever
Paratyphoid fever	Yellow fever

DISEASES WHOSE IMMUNITY IS NOT LASTING. During an attack of the following diseases, not enough antibodies are formed to be of any service in preventing another attack. Indeed, one attack even increases susceptibility to some of them, especially to those starred.

*Colds (including sinus infection, tonsilitis, laryngitis, bronchitis and "grippe")

Conjunctivitis	Pus germ infections in general
Erysipelas	Septic sore throat
Gonorrhea	Syphilis
Hookworm	Tetanus
*Influenza	Trachoma
Malaria	Trichinosis
Pneumonia	Tuberculosis

*Rheumatic fever (including rheumatic heart infection)

DISEASES HAVING HEREDITARY AND CONGENITAL IMMUNITY. Human beings are hereditarily immune to diseases of animals, with certain important exceptions (e.g., rabies).

In respect to diseases of man, some races enjoy a high degree of resistance if not complete immunity to some infections common in other races (e.g., the Hebrew people are relatively resistant to tuberculosis). Within races, differences in resistance are due to causes other than inheritance of specific antibodies.

Congenital immunity, lasting for a few months, is common in the case of diphtheria and several other diseases, the mother having had antibodies either because of an attack of the disease or from subclinical infection. Unless thus immune for a time, infants are as a rule especially susceptible rather than resistant to infections.

DISEASES HAVING SUBCLINICAL INFECTION IMMUNITY. For one reason or another, those who have not had the following diseases are not all equally susceptible to them. Some persons appear to be completely immune to one or more of them, as shown by their not taking

them when thoroughly exposed. Others are only relatively resistant and will become infected if sufficiently exposed. The explanation in many such cases is thought to be previous and probably repeated exposures, which produced antibodies but not illness.

Diphtheria	Scarlet fever
Encephalitis	Tuberculosis
Infantile paralysis	Typhoid fever
Influenza	Undulant fever
Meningitis (meningococcus)	Vincent's infection

Obviously, no such immunity can be counted on unless it can be proved by tests such as the Schick test for diphtheria or the Dick test for scarlet fever. For most of these diseases, no such tests are available.

IMMUNITY FROM VACCINES. One of the greatest triumphs of science was the discovery that the formation of antibodies may be stimulated artificially by antigens made in laboratories and introduced into the body by inoculation. These laboratory-made antigens are called vaccines. Vaccines contain bacterial products but are not capable of causing the disease—only of producing antibodies against it.

Vaccines are used in advance to prevent diseases. Each vaccine is specific against a specific type of infection.

The use of vaccines began with Dr. Edward Jenner, an English physician, who discovered vaccination for smallpox. As yet, vaccines are not available against all infections.

Vaccines are available for prevention of several diseases to which all persons are exposed early in life. It is therefore recommended (by the Committee on Immunization Procedures of the American Academy of Pediatrics) that the sequence of immunizations listed in Table 14 be carried out during infancy and childhood.

Many physicians would also add the Dick test for immunity to scarlet fever before school age, followed by immunization if necessary, and immunization against typhoid and paratyphoid fever in childhood, to be repeated every year or two, especially in the case of those living or visiting in rural regions.

If the inoculations mentioned have not been received in childhood, they should be obtained by the adult unless tests prove they are not needed. Exceptions might be scarlet fever and whooping cough.

Preventive inoculations may also be done against the following diseases, in the case of those who are especially likely to be exposed to them: cholera, plague, Rocky Mountain spotted fever, tularemia, epi-

Table 14

IMMUNIZATION IN CHILDHOOD*

Age	*Immunization Procedure*
3 to 12 months .	Smallpox vaccination—may repeat at 6 to 12 years of age
9 to 12 months .	Diphtheria immunization—repeat age 3 or 4 years
6 to 9 months ..	Whooping cough immunization—repeat ages 3 or 4 years
9 to 12 months .	Injection of diphtheria and tetanus combined toxoids (repeat at age 3 or 4)
	12 to 18 months—booster injections may be given
Regular intervals of about 1 year	Schick test for immunity to diphtheria may be given
After 1 year	Injection of scarlet fever toxin (optional)
1 to 2 years . .	Injection of typhoid vaccine in endemic areas or when travel to such areas is contemplated (repeat at intervals of 2 years)
After 4 years	Booster inoculations against diphtheria, tetanus, and pertussis (whooping cough) other than those recommended at 12 to 18 months and 3 to 4 years)

* Adapted from report of Committee on Therapeutic Procedures for Acute Infectious Diseases and on Biologicals of the Academy of Pediatrics, 1943. 5th edition of *Textbook of Pediatrics*, Mitchell-Nelson, 1950.

demic typhus fever, undulant fever, and yellow fever. The most recently developed vaccine, that against influenza, first became available to the public in 1945. (See p. 242.) In the experimental stage are BCG vaccine to prevent tuberculosis and a vaccine to prevent mumps.

Rabies vaccine is available for prevention of rabies. It is administered not in advance of, but after, the bite of a rabid animal. The vaccine causes immunity to appear before the disease, which has a long incubation period.

Vaccines are available against the pus germ infections. In some conditions, single or mixed vaccines, or autogenous vaccines (vaccines made from an individual's own germs), are useful to limit recurring pus germ infections. Although pus germs are the secondary invaders in colds, vaccines made from them are not often successful in preventing colds.

Serum-increased Resistance. When infection is actually present, antibodies against it may not form fast enough to save life. In such cases, if ready-made antibodies are available from outside sources, recovery will

be more certain. In fact, recovery from some diseases is unlikely unless additional antibodies are promptly received.

The outside source of antibodies is the blood either of humans (recovered cases who still have an excess of antibodies) or of animals who have been given antigens to stimulate their formation of antibodies. In either case, the blood is withdrawn and prepared for use under strict laboratory procedures. Only the serum is used.

Serum is used for treatment to supplement what the body is already doing to combat infection. It does not stimulate the body to form more antibodies, and the serum antibodies are not lasting; hence, it is not useful in prevention (except sometimes when a person has already been exposed and is expected to develop the disease shortly).

Diseases Having Serums Available for Treatment. Among the important serums are the antitoxin for diphtheria, which has undoubtedly saved millions of lives, and the antitoxin for tetanus. For both of these diseases, serum must be used promptly to have its greatest effectiveness. Most of the other available serums have been superseded by the sulfa drugs, penicillin, streptomycin, and other drugs as treatment.

Variations in Resistance

As stated, tissues that are normal offer greater resistance to infection than those that are not normal and thus not able to perform their usual protective functions.

Abnormalities that render skin and mucous membranes more susceptible to infection are a *break in continuity,* allowing germs to enter deeper layers where conditions are especially favorable for their nutrition or allowing them to enter directly into the blood stream; *irritation from mechanical causes,* impairing normal function of the tissues (e.g., boils are common in men on the back of the neck where the collar has rubbed); *irritation from chemical causes* (e.g., boils in women are common under the arms following injury by rough application of chemicals to check perspiration); *soiling* by dirt from the outside world or debris of body secretions (e.g., gum infection in a foul mouth); and numerous other local conditions that are part of a general condition.

General Conditions Affecting Resistance. Normal health undoubtedly favors the processes the body must perform to prevent and to overcome infection. Although it cannot be relied upon to take the place of specific vaccines and serums when such are available or specific treatment by drugs, good health can be relied upon to do something—and perhaps a

great deal—to prevent infection from starting and to cure it if it does start.

The following general states of the body are unfavorable to resistance:

1. Youth, especially extreme youth.
2. Senility.
3. Defective function of endocrine glands, especially the cortex of the adrenal gland.
4. Altered body chemistry (e.g., decrease of alkali reserve, increase of blood sugar, presence of alcohol in tissues).
5. Loss of blood, anemia from other causes.
6. Adverse temperature changes, especially chilling.
7. Overfatigue, especially when prolonged.
8. Chronic constitutional diseases of some types (e.g., diabetes).
9. Poor circulation from inactive habits or other causes.
10. Other infections already present, acute or chronic.
11. Convalescence.
12. Dietary deficiency of protein.
13. Dietary deficiency of minerals, especially of calcium.
14. Dietary deficiency of vitamins, especially of A and C.
15. General malnutrition.

How Do Medicines Aid Resistance? Apart from their use to destroy germs or to check germ growth, medicines are often useful during infection for improving the body's condition and its ability to combat infection. For example, medicines may be required to support a failing function (for example, heart action), to aid in the eliminations of waste products of metabolism, to promote sleep and rest, and for various other purposes. These effects may be required in addition to whatever other treatment is given either to increase the antibodies or to destroy germs. Frequently, the scientific use of medicines for such purposes turns the tide when the body is having difficulty overcoming germs.

10

Avoiding Injury by Physical Agents

Physical Injuries and First Aid. The need to render first aid to one's self or others occurs so frequently that everyone should receive thorough training in it. Lives are often saved by prompt and correct action on the part of an amateur with training, but death or crippling have often resulted from blunders made by those attempting to help the injured and not knowing what to do and what not to do. Courses in first aid are given in nearly every community by such organizations as, for example, the American Red Cross.

The American Red Cross issues two first aid textbooks, one for adults and a more recent First Aid Textbook for Juniors, which are used for community and school courses. Textbook knowledge of first-aid measures is not enough; supervised practice in technic is essential in the case of many of them. Manuals such as these, however, are of great value even to the unpracticed.

The scope of this volume permits only a few brief suggestions for treating minor injuries and a few important warnings.

Precautions to Be Taken Regarding the Seriously Injured. A person who is or appears to be seriously injured may have suffered internal injuries or be in a state of shock, for which reason the following precautions should be taken:

1. He should be kept lying down, with head level or only slightly raised.

2. He should not be moved if it can possibly be avoided. Rather than take him to a doctor, take a doctor to him.

3. If he must be moved, his position should not be changed more than necessary; he should be kept lying down on an improvised stretcher.

4. He should be kept warm by covers over him (and under him in cold weather outdoors).

Unless one has received training in dealing with such matters as hemorrhage or stoppage of breathing, one is not in a position to be of much use except by obtaining professional aid as quickly as possible. As for fractures (broken bones), dislocations of joints, sprains, and the like, it does less harm to allow them to await medical care than to handle them inexpertly.

What Injuries May the Nonmedical Person Treat? Usually it is safe for the layman to treat (1) certain contusions (bruises). A contusion is an injury produced by impact, which affects the skin and the tissues beneath it but does not break the skin.

Also, the layman usually may treat (2) minor wounds. A wound is an injury in which the covering membranes of the body are broken. Common wounds are abrasions (small superficial wounds), lacerated or torn wounds, penetrating or stab wounds, of which the pinprick is the smallest, cuts, scratches, bites, stings, etc.

Both contusions and wounds often occur from the same violence that causes other injuries. Therefore the possibility of more serious injury should not be overlooked, even when contusions and wounds appear trivial.

Precautions Regarding Contusions. Any of the following contusions should certainly be examined by a physician:

1. Any severe contusion (extensive in breadth or depth).
2. Any contusion accompanied by unconsciousness.
3. Any head contusion except the most trivial. (Brain injury may follow a blow on the head, without causing skull fracture or unconsciousness.)
4. Any eye contusion, usually shown as "black eye." (If vision is impaired, the retina may have been detached.)
5. Any contusions of the trunk if there are any signs of shock (see p. 55) to suggest that an organ has been ruptured.
6. Any contusion of any moment on the back or neck. (A small fracture of a spinal vertebra may not be suspected by the symptoms, yet it requires treatment.)
7. Contusions near joints if the joint is at all disabled. (Bleeding may take place into joints.)
8. Contusions of the nails with blood beneath. (Boring a hole through a nail in order to let out the blood is not a safe practice for an amateur.)

Trivial contusions are relieved by cold compresses (cloths wrung out

of cold water), followed after a few minutes by hot compresses or hot soaks.

Treating Minor Superficial Wounds. For the amateur treatment of minor superficial wounds, the following procedures usually are safe and often sufficient.

CLEANSING. A wound containing ground-in dirt or foreign particles should be cleaned only by a physician. Ordinarily it is not necessary or beneficial to wash a wound.

DISINFECTION. A disinfectant should be applied in such a way as to reach every part of the wound and some of the surrounding tissue. The chemical may be applied by pouring it directly into the wound (which method is preferable in cuts and lacerated irregular wounds), or it may be applied by means of a glass rod or a swab (cotton wound around the end of a small stick).

For the layman, half or quarter strength tincture of iodine is the most satisfactory skin disinfectant, as it interferes least with tissue resistance. Usually one application will suffice, if the wound is properly cared for thereafter. The hands and everything nonsterile must be kept away from the wound after it is sterilized.

(Redrawn from *Today's Health*, formerly *Hygeia*.)

DRESSING. The sterilized wound should be covered with sterilized gauze, cloth, or bandage and secured by adhesive tape, tied, or pinned with a safety pin.

Sterile gauze folded into pads may be purchased ready for use, in individual sealed glassine envelopes. A convenient dressing for small wounds consists of a small pad of gauze with adhesive attached, ready to apply, each done up in a sterile envelope.

If no sterile goods are at hand, a clean handkerchief or any soft, clean cloth may be ironed until slightly scorched, and the scorched side, untouched by the hands or anything else after being ironed, applied to a wound. In an emergency, the inside of a fresh folded handkerchief may temporarily be applied to a wound. If there is doubt about the sterility

of all available materials, it is better to leave the wound uncovered, with care to keep it from further contamination. However, if severe bleeding is taking place, it would be better to take a slight chance of infection rather than a serious chance of fatal bleeding, but before applying anything nonsterile to a wound it should be certain that the bleeding is serious. A little blood often looks like a great deal to the novice.

Adhesive plaster should not be applied directly to a wound (except in special circumstances, by physicians), nor should flexible collodion. They are to be used on wounds only to hold dressings in place.

When the abraded surface is large, it may be desirable to use an ointment after the wound has been sterilized before the dressing is applied, to keep the dressing from sticking to the wound. The ointment (e.g., boric) should be applied directly from the tube and if necessary should be smoothed over the wound by means of sterile material.

The dressing should be kept dry. If it accidentally becomes wet it should be removed and the wound resterilized and redressed.

INSPECTION. The dressing on very minute wounds may be removed in 24 hours for inspection, and, if there are no signs of inflammation and healing seems complete, need not be replaced. From larger wounds (self-treated) the dressing should be removed at the end of 24 hours for inspection. If the dressing sticks, it may be soaked off in warm water. Adhesive attached to the skin may be loosened by gasoline, ether, or cleaning fluid. If it has been necessary to wet the wound, it should again be sterilized and dressed. If the wound has not been wet, nothing nonsterile has touched it, and there are no signs of inflammation, a fresh dressing may be applied without resterilization and left in place until it is thought that healing is complete. The larger the wound, the longer it takes for it to heal.

It will be recalled that the signs of inflammation are redness, swelling, pain, and heat. If these symptoms are present, a physician should be consulted. Even before the time of inspection, symptoms of inflammation may make themselves evident and, if so, should receive prompt attention. Small red lines in the skin, radiating from the wounded area, indicate infection of lymph vessels (lymphangitis). This is always a sign that medical attention is urgently needed. The need is even more urgent if there is pain or swelling of lymph nodes nearby (e.g., under the arm, in case of injury to the hand).

Dressing Foot Wounds. First, since the feet are near the ground, they always carry, even in the most cleanly, a large number of bacteria. Therefore a wound on the foot is likely to be contaminated as soon as it occurs or to become so shortly. Second, wounds on the feet are difficult to dress in such a way as to favor comfort and prompt healing.

A wound on the foot must be cared for at once. This is true especially of a penetrating wound (e.g., by a nail). But even small blisters, such as those caused by poorly fitting shoes, should be treated at the earliest possible moment. All foot wounds should be thoroughly sterilized. If they are on a part of the skin that is thick and horny, a long soaking in a hot antiseptic solution (e.g., boric acid) will soften the skin in preparation for sterilization.

The type of dressing used on the foot must be such as to relieve the injured area of pressure by shoes. After applying several layers of gauze directly over the wound, a doughnut-shaped pad should be applied, with the opening the same size as the wound. (Fold several layers of gauze twice, cut off the folded corner, open, and trim the outer edge to suitable size.) Another layer of gauze should then be applied, and the whole be secured by adhesive tape to keep the edges from rolling while putting on the stockings.

Corns may be treated by commercial corn preparations used strictly according to directions. Calluses require medical attention.

Checking Bleeding. Almost all injuries rupture blood vessels, either small or large, and blood either collects in tissues or is discharged on the surface. In either case, the tendency of blood is to clot when outside blood vessels, and the clot checks further flow of blood.

The treatment for external bleeding is pressure directly upon the bleeding area, using the hand holding a pad of sterile gauze. Pressure should be maintained steadily until a clot has formed (a variable time, according to the type of wound and the individual's clotting time). If the flow of blood is brisk and thought to be from a large vessel, pressure should be maintained until a physician can attend to the wound.

An advantage of first-aid training is that one learns how to stop hemorrhage not controllable by pressure on the bleeding point. The other two first-aid measures are pressure upon the main artery from which the blood is coming and the use of a tourniquet for bleeding from a limb. The untrained cannot use either of these methods effectively or safely and should not attempt to do so, except possibly to use a tourniquet in a dire emergency.

A nosebleed should be treated according to the same principle. The tip of the finger, covered with a clean handkerchief, should be pressed against the middle partition of the nose (septum) where most nosebleeds originate, held motionless for 3 to 5 minutes or longer, and then removed gently so as not to disturb the clot.

Internal hemorrhage may result from violence which does not break the skin. It is a particularly serious condition which may be suspected in severe injuries such as crushing blows, especially if the victim appears to be in collapse or shock. Whether the victim is unconscious or not, the first aid treatment is for shock as described on p. 55.

Treatment for Penetrating Wounds. When a wound goes deep into the skin but has a small surface opening, bacteria which may have entered the wound are likely to be sealed within it when the opening closes over. They are then in an airless medium, which is particularly favorable for certain types of bacteria (anaerobic) such as the tetanus (lockjaw) bacillus. Special methods must be used by physicians to sterilize penetrating wounds, and sometimes tetanus antitoxin must be given, especially to those who have not been immunized to tetanus. In deeply penetrating wounds there is also the danger that important structures beneath the surface may have been injured.

How May Cuts Be Dressed? A cut made by a sharp-edged instrument may sever blood vessels and bleed freely. Also, the instrument may have introduced bacteria deep into the wound. After the danger of infection has been obviated by thorough sterilization of the tissues to the depth of the cut and bleeding controlled by pressure, the cut should be dressed as a wound. Cuts of any moment usually require medical attention.

Cuts heal readily if the edges are in contact or can be brought into contact. In dressing a cut, this fact should be kept in mind. In deep or large cuts, it may be impossible to keep the wound from gaping unless "stitches" are taken to bring the edges together. Even smaller cuts in a location where a scar would be objectionable may require stitches for perfect approximation of the edges.

Suitable Treatment for Burns. Burns result either from friction (as in sliding down a rope), heat (including electricity, etc.), or chemicals (strong acids or alkalis). From whatever cause, burns are of three degrees: first degree, skin reddened; second degree, skin blistered; third degree, skin and some of the underlying tissue destroyed.

The first-aid treatment for small skin burns of any degree may be the application of petroleum jelly (such as Vaseline), covered by sterile

gauze fastened firmly but not tightly. Burns covering a wide area and all third degree burns should receive medical attention. If such is to be available within a short time, it would perhaps be better to render no first aid in the case of third degree burns except to cover the area with a soft sterile cloth. The danger of any handling of such burns would be that germs might be carried into the wounded tissues. Even when clothing is adherent to the burn, it should be left in place until medical care is at hand.

Treating Blisters. In a blister, the outer layer of the skin (epidermis) is raised, with fluid separating it from the true skin (dermis). The dermis is sensitive and easily infected; therefore, it should be kept covered by the blister until the fluid is absorbed or at least as long as that can be managed. To keep the blister whole, it should be covered by ointment and gauze and kept dry. If the epidermis is accidentally broken and partly rubbed off, the edges may be trimmed with sterile scissors and the area treated as a wound.

Removal of Foreign Bodies. Foreign bodies such as splinters in the skin, if superficial, may be removed by means of a sterilized needle. The skin should be wiped with alcohol before and after the process. The area should then be treated as a wound.

If deeply situated, its removal should not be attempted by an amateur. An object that causes a deep stab wound should be left in place until conditions are suitable for its removal (e.g., in a hospital); it acts as a wedge that to some extent prevents bleeding, and a severe hemorrhage may occur as soon as it is removed.

If a foreign body in the eye cannot be flushed out of the eye by tears or by 4 per cent boric acid solution, expert treatment is required.

What Is First Aid for Mechanical Suffocation? Suffocation may occur as a result of foreign bodies in the trachea or bronchi (choking) or as a result of water cutting off the air supply to the lungs (drowning).

Ordinarily, the person who is choking will cough out the foreign body if left alone. It is mistaken kindness to interfere with his reflexes by pounding him on the back. If, however, he does not promptly rid himself of the substance, he may be placed against the wall, facing it, and slapped, not too hard, on the back between the shoulder blades with the flat of the hand. A small person may be held upside down by the feet while another person taps him. In some cases, the foreign body cannot be removed except by the fingers or instruments of a physician. If it becomes apparent that coughing is not going to be immediately suc-

cessful in dislodging the foreign body, a physician's assistance should be obtained at once.

Drowning: Artificial Respiration. With the increasing emphasis on vacations in the United States, drownings are far too frequent. Of course, prevention by learning to swim at an early age or by avoiding deep water is desirable but not always successful. Even when a person is unconscious from immersion, first aid by artificial respiration should be used. Although one may learn this technic from first-aid manuals, it is highly desirable that it be practiced under expert supervision.

Administering artificial respiration, usually by manual means on the part of the operator, causes air to flow in and out of the lungs. The lungs must be emptied of water and breathing started again by alternately compressing the lungs, then releasing the pressure.

Artificial respiration is also used for asphyxiation from certain kinds of chemical poisoning (see Chapter 11) and for electrocution.

Electrocution. Electrocution causes cessation of breathing. It most often results from (1) touching charged electric wires that are bare or have a defect in their insulation, or (2) handling wires or fixtures with materials that are good conductors of electricity which render insulating materials ineffective. The body when wet is a particularly good conductor of electricity, and fatal accidents have occurred from touching electrical cords or fixtures with wet hands.

The treatment of electrocution consists, first, of removing the victim from contact with the current. This should be done not by touching him with the hands (or the rescuer also will be electrocuted) but with a nonconducting material, such as dry wood or a dry woolen coat. Second, artificial respiration should be used if the victim is not breathing and should be continued as long as there is any chance of saving him. Third, after the effects of electrocution are overcome and the victim is again conscious, his electrical burns should be treated.

What Does Unconsciousness After Injury Mean? When a person is unconscious after an injury, the cause may be syncope (fainting) due to too little blood in the brain centers. This is likely to be the case if the injury does not appear to be serious, but caused by fright. But unconsciousness after severe injuries, and even after some minor ones, may be due to shock or collapse, which consists of a profound depression, possibly fatal, of all vital functions. Both fainting and shock were discussed in Chapter 3.

Shock should be suspected after (1) extensive injury anywhere on

the body, (2) head injuries, and (3) severe hemorrhage (although bleeding may be internal and suspected only because of the type of injury and the signs of shock).

First-aid treatment for the seriously injured, whether conscious or not, was mentioned on p. 55. If the victim is unconscious from any cause, no attempt should be made to give him anything by mouth lest it run into the air passages and choke him.

11

Avoiding Injury by Chemical Agents

Every phase of life has its chemical aspect, and virtual poisoning often occurs from within the body, by substances resulting from deranged function. In this chapter only external sources of poisoning will be discussed.

What Are Poisons? Poisons are chemicals that are quantitatively or qualitatively foreign to the body and harmful to it. In form they are solids, liquids, or gases. Their degree of toxicity varies according to the kind of poison, amount, dilution, point of application to the body, and individual susceptibility. The action of a poison is either local where applied or systemic after absorption, or both. Local damage ranges from none to irritation of varying degree up to destruction of tissues (as by corrosive acids and alkalis). Systemic damage may involve any or all functions; if vital functions such as heart action or respiration are deranged, death may ensue. Poisoning occurs as an acute condition or as a chronic one.

Accidental Poisoning and First Aid

In the United States in 1948 there were 2900 accidental deaths from poisons, or one-eleventh the number caused by automobiles in that year. Of these, 1450 were due to gaseous poisons (967 to carbon monoxide), and 1450 were due to liquid or solid chemicals, chiefly self-administered medicines, with barbituric acid or its derivatives accounting for more than one fourth of all total accidental poisoning in the United States at the top of the list.

Formerly, poisoning occurred frequently in industrial plants, but the use of scientific precautions on the part of the employees and employers has greatly reduced this hazard. Lead poisoning, however, still remains an important hazard in certain occupations.

Principal industrial toxicologist Lawrence T. Fairhill carrying out a lead arsenate absorption experiment. Division of Industrial Hygiene. (Courtesy, U.S. Public Health Service.)

Carbon Monoxide Poisoning. Carbon monoxide poisoning occurs most often as a result of (1) escape of utility gas through defective rubber tubing and fittings, (2) imperfect combustion in stoves and furnaces, and (3) automobile exhaust gas.

Carbon monoxide kills because it combines with the hemoglobin of the blood, thereby preventing oxygen from doing so. Death results from asphyxiation unless artificial respiration can be applied quickly enough.

Gas installations of all sorts should be inspected frequently. Stoves and furnaces must be operated by skilful manipulation of drafts so as to supply plenty of oxygen. Automobile engines should not be run in closed places, for their exhaust gas always contains carbon monoxide in concentration strong enough to be fatal in a few moments without warning symptoms.

Danger of Lead Poisoning. Lead poisoning results chiefly from swallowing minute lead particles taken into the mouth either from lead-contaminated hands or from a lead-contaminated atmosphere. Lead is used in many industries and trades. A person using a compound with-

out realizing that it contains lead, without realizing its dangers, and without taking suitable precautions may acquire lead poisoning in a short time (e.g., an amateur painter while painting his house). Lead poisoning may occur from lead pipes in domestic plumbing, especially when they carry water with a high percentage of carbonic acid, which dissolves the lead.

The symptoms of chronic lead poisoning are eventually a blue "lead line" at the edge of the gums, weakness of the muscles due to neuritis (inflammation of the nerves), and anemia.

The danger of lead poisoning may be greatly reduced by taking due sanitary precautions, especially regarding washing the hands before eating.

Accidental Poisoning in the Home. Poisoning at home occurs largely because certain substances in common use are not recognized to be poisonous or are confused with something harmless.

Many disinfectants, germicides, insecticides (e.g., nicotine used on plants), and substances used to kill rats and mice are poisons of one sort or another. So also are many polishes, cleaning pastes or fluids (e.g., some silver polishes contain cyanide), photographic chemicals, shoe dyes, hair dyes, and, of course, many medicines.

Fatalities from poisons in the home occur most frequently among children. Therefore, it is highly important that all such substances as those mentioned be kept in a place by themselves, apart from harmless substances, out of reach of children, and not too readily accessible even to adults. They should be clearly labeled, and the label should be read before the substance is used. Obviously, this is particularly necessary in the case of substances taken internally. Any chemical substance that has lost its label should be discarded; it is hazardous to try to identify it by sight or smell. No dangerous chemical should ever be put into a container ordinarily holding harmless substances (e.g., a milk bottle or a drinking glass). Also, the materials and utensils used in applying poisonous chemicals should either be thoroughly cleaned or destroyed immediately after use. Finally, the hands should be protected so far as possible while using a poison and while contaminated should be kept away from the mouth, nose, eyes, and foods.

First Aid in Poisoning. Whenever possible, in case of poisoning, a doctor or someone who has some special knowledge of the body and also of chemicals (druggist, dentist, nurse, or veterinarian) should be called at once.

Even though medical care is to be available promptly, those at hand should render first aid as follows:

1. Ask the victim what he took. If possible save the container for the doctor's examination.

2. Induce vomiting at once. Give four to eight glasses of water. (Lukewarm water may be more effective than cold; soapy water may be more effective than clear. The fluid serves to dilute the poison as well as to cause vomiting.)

If a corrosive poison was taken, as indicated by burns in and around the mouth, its destructive action may be checked by giving milk, a solution of starch and water, or egg white and water. These may be substituted for some of the clear or soapy water.

If acid was taken, the fluid given may be a weak solution of milk of magnesia; the latter is recommended, if available, in preference to other alkalis. If alkali was taken, weak lemonade or a weak solution of vinegar may be given. These neutralizing agents should be given if at hand.

If vomiting does not occur following the use of one or more of the fluids mentioned, it will usually occur at once after the back of the victim's throat has been tickled gently by a finger.

3. After the victim has vomited, repeat the same measures.

4. Do not waste time trying to obtain the antidote for the poison. Nevertheless, if it is known what chemical was taken and what the antidote is, if it is at hand, the antidote should be administered promptly.

The following mixture is called by toxicologists a universal antidote, to be given when more specific treatment is not possible: a mixture of two parts of pulverized charcoal, one of magnesium oxide, and one part of tannic acid. Administer one heaping teaspoonful in a small glass of warm water.

5. Attend to the individual's general condition. For example, if the victim's respiration is slow and weak, he may need artificial respiration; if he has taken a narcotic and seems drowsy, efforts should be made to keep him awake; if he is in a state of shock, he should be kept horizontal.

Treatment of Chemical Burns. Chemicals that have caused burns must be neutralized, diluted, or removed, at once. Water in large quantities serves these purposes in most cases. Also (except in chemical burns of the eye, a particular case), a specific neutralizing agent, if at hand, should be used (for example, a weak alkali, such as sodium bicarbonate

or baking soda, should be used on acid burns, and a weak acid, such as vinegar, on alkali burns). Subsequently, a bland ointment (e.g., boric) should be applied to slight burns and medical treatment secured for others.

Medicines Self-prescribed

Medicine as a Cause of Poisoning. Probably the largest proportion of all poisoning from without comes, ironically enough, from substances taken with the expectation of help rather than harm.

Medicines are safe only when prescribed by physicians who know the properties of the medicine and the condition of the person for whom it is prescribed. Self-medication is a danger whether the medicine is an official drug such as physicians use or a nostrum such as are advertised to the public and bought by them to the extent of $360,000,000 worth a year in this country.

If a person is ill enough to need medicine he is ill enough to need a doctor. If he takes medicine that is capable of affecting the body at all, it may affect it for the worse. For example, even a "simple" cathartic, if given to an individual who has an acute appendicitis as the unsuspected cause of his "stomach-ache," might stir up peristalsis to such an extent as to rupture the diseased appendix. Similarly, a medicine to relieve pain may cause one to be falsely comfortable while the cause of the pain progresses, as, for example, while an ear abscess is extending to the mastoid cells. If the pain had not been relieved, the progress of the ailment would probably have been noted and checked before serious harm was done. Also, the use of stimulants that cause one to feel braced up may cause one to overdo without realizing it. Like whips, stimulants are not for regular use. Even for occasional use, stimulants are unsafe except when medically prescribed.

What Rules Should Govern the Taking of Medicine? The well-informed and duly cautious person will not be reluctant to abide by the following rules:

1. Do not take any medicine not prescribed by a physician.
2. Take such medicine only according to directions.
3. Do not repeat the prescription except upon the physician's request; "enough is enough."
4. Do not have the prescription filled later for another illness except with the physician's approval (even though the symptoms seem the same, the second illness may need quite different treatment).

5. Do not take any leftover medicine but discard everything of the sort as soon as the immediate need for it is over (medicine may take on poisonous properties as it deteriorates with age or become stronger because of evaporation of solvents).

6. Shake liquid medicine before taking it, to avoid having any poisonous ingredient all in one dose, as may be the case with medicines that separate while standing.

7. Do not take medicine prescribed for another person, even though the illness is believed to be the same.

Important Laws Regarding Medicines. It has long been illegal for any but licensed physicians to prescribe medicines. Before 1906 all medicines could legally be sold "over the counter" to the public without a physician's prescription.

In 1906 the United States Congress passed the Pure Food and Drug Act, whereby it became illegal to sell medicines containing more than a given amount of any of eleven narcotics without a prescription. This Act did much to protect the public against narcotic poisoning, but it was not sufficiently inclusive.

In 1938 the Food, Drug and Cosmetic Act was passed. It extended the list of narcotics to include certain hypnotics and provided additional protective measures, as follows:

LABELS. First, if a medicine on sale to the public contains any of the following narcotics and hypnotics in any amount whatever, the name and amount of the drug must be stated on the label, with the words "WARNING—MAY BE HABIT-FORMING."

Alphaeucaine	Codeine
Barbituric acid	Heroin
Eucaine hydrochloride	Morphine
Bromal	Opium
Cannabis (marihuana)	Paraldehyde
Carbromal	Peyote
Chloral hydrate	Sulfonmethane
Coca (cocaine)	

or any chemical derivative of such substances

Second, if a medicine contains any of the following powerful drugs or their derivatives, the name and amount of the drug must be printed on the label, with warning as to possible harmful effects.

Acetanilid	Antipyrine
Acetophenetidin	Arsenic
Aminopyrine	Atropine

Bromides	Mercury
Chloroform	Ouabain
Digitalis	Scopolamine hydrobromide
Digitalis glucosides	Strophanthin
Ethers	Strychnine
Hyoscyamine	Thyroid

Third, the name and amount of the active ingredient of a medicine—whatever its nature—must be stated on the label, with suitable warning about its danger. For example, castor oil bears the following warning: *"Not to be used when abdominal pain (stomach ache, cramps, colic), nausea, vomiting (stomach sickness) or other symptoms of appendicitis are present. Frequent or continued use of this preparation may result in dependence on laxatives. Do not use during pregnancy except on competent advice."*

TESTING. By the same Act, testing of drugs by the Food and Drug Administration was provided for. New drugs must be tested and approved by scientific authorities before being placed on sale.

ADVERTISING. A third method of control is regulation regarding the advertising of medicine. The Federal Trade Commission has this matter in charge. Fine or imprisonment is the penalty for anyone who fraudulently advertises medicine that "may be injurious to health when used under conditions mentioned in the advertisement."

In addition, the Post Office Department can take action against those who use the mails to defraud, and this applies to those sending fraudulent advertisements of medicines through the mail.

Habit-forming Drugs

A drug is called habit-forming when use engenders more use. The taking of such a drug becomes a fixed mode of reaction usually accompanied by a feeling of physical or mental craving or compulsion, regardless of reason.

Included in the list of habit-forming drugs are the alcoholic beverages, the narcotics and hypnotics listed on p. 227, and tobacco which, although not precisely in the same category, will be discussed in this section.

ALCOHOL

Alcohol addiction is a major health problem in this country. As such it will be discussed in connection with other problems of comparable importance in Chapter 13.

Narcotics and Hypnotics

Many of these drugs are valuable in medical practice for the relief of pain or promotion of sleep, but all are potentially harmful. Addiction to them is likely to lead to illness of body or mind or both. Medically and socially, drug addiction is a serious problem throughout the world.

In some countries, addiction to the narcotic opium and its derivatives, morphine and heroin, is prevalent. In this country, government vigilance has appreciably reduced the rate of addiction to these drugs. But addiction to the narcotic marihuana has increased proportionately because the hemp plant can be grown surreptitiously almost anywhere. Addiction to the hypnotics, also, has increased in spite of increased measures for government control.

Why Does Addiction Occur? Often the habit of taking a drug is firmly established before the individual realizes the nature of the drug he is taking. He begins by dosing himself with a medicine to aid sleep or relieve pain or calm nerves or to obtain a sense of well-being called euphoria, often described as a "thrill." In the case of narcotics, the drug usually has been recommended to him by those who are its victims or by unsuspected agents of the illicit trade in these drugs, whose business it is both to create a demand for drugs not legally obtainable without prescription and to supply the demand in "bootleg" fashion and at bootleg prices.

It is believed that whereas any type of person may become an addict to drugs, those of unstable personality are especially prone to do so. For whatever reason the drug is first taken, its use is continued because all these drugs have power to blur and obliterate the unpleasant and to induce euphoria. Once the neurotic person has experienced such results, he craves the drug as the quickest means to temporary ease.

To guard again drug addiction one should (1) refuse to take any medicine not prescribed by one's own physician, especially any medicine claimed to have magic powers to induce pleasant feelings; and (2) cultivate a state of mind and habit of life which furnishes euphoria through satisfying work and play—that enables one to face the unpleasant and turn it into the pleasant through real life rather than through drug-induced phantasy or oblivion.

Drug Addiction Can Be Cured. In the case of the hypnotics (e.g., barbital) the will to stop them, together with the will to readjust one's

faulty habits and attitudes, is often successful. In the meantime, the drug may have harmed the health, possibly irreparably.

In the case of the narcotics, the addict usually is hopelessly shackled in efforts to free himself of the habit by his own will. He needs, in addition, the help of others and usually medical care in a hospital.

Hospitals for narcotic addicts aim not only to stop the use of the drug but to rehabilitate, to restore to health, and to train to be self-supporting. Reports from government hospitals indicate that 30 per cent of discharged patients remain well.

TOBACCO

Undeniably, tobacco is habit-forming. Equally undeniably, it is injurious at least to some persons to some extent and possibly to more persons and to a greater extent than as yet conclusively proved.

Tobacco and Length of Life. A recent statistical investigation suggests that further study of the physiologic effects of tobacco is needed. In 1938 Raymond Pearl, of Johns Hopkins University, reported on the length of life in relation to use of tobacco. From the records of over 6000 white males he found that "smoking is associated with a definite impairment of longevity." The shortening of life was in proportion to the amount of tobacco used. Later, he reported on 300,000 individuals —100,000 each of heavy smokers, moderate smokers, and nonsmokers. At the age of sixty, 66,564 of the 100,000 nonsmokers were still living; 61,911 of the moderate smokers, and only 46,266 of the heavy smokers.

This report, being a statistical one and concerned only with length of life, gives no evidence of the nature of the damage assumed by Dr. Pearl to have taken place in the smokers. Toxicologists list an imposing array of poisonous effects of nicotine, and it may be supposed that in the individuals whose lives apparently were shortened by its use one or more of these effects was either a primary or a contributory cause.

Nicotine Affects the Nervous System. In moderate doses, tobacco appears to exert a stabilizing effect on nervous equilibrium. It induces a temporary state of calm and repose, obscuring the sense of fatigue and discomfort. In heavier doses, it may increase nervous excitability. Also, it may do so in habitual users in the intervals between smoking. It appears that those who are of a nervous temperament are most likely to feel the need of the "soothing" effect of tobacco, to repeat the dose more and more frequently, and eventually to show a more or less perpetual nervous irritability.

As for the effect on mental performance, tests have given contradictory results. Most tests of the young have shown a poorer performance for smokers than nonsmokers. In a habitual smoker subject to nervous tension when deprived of tobacco, the relaxation after smoking may make possible a better mental performance than before smoking, the improvement lasting a few moments, until the irritability returns. On the other hand, those who have become chronically poisoned often show general slowing and lack of energy in mental work.

Various other manifestations of the toxic effect of tobacco on the nervous system have been noted. For example, some individuals experience enough neuromuscular incoördination in the small muscles of the hands to make their hands unsteady for fine work. In others, the eye muscles may be similarly involved. Vision itself may be impaired. Tobacco blindness is rare, however, occurring almost exclusively in those who also use alcohol to excess.

Nicotine and the Heart. It has long been known that tobacco has a tendency to disturb the function of the heart. When pronounced, such functional disturbance gives a condition known as tobacco heart. Although it involves no organic changes, it does lessen the ability of the heart to bear up under strain of any sort, including exertion and illness. There is also the possibility that continued poor function might in time do structural damage. In a given case, whether or not tobacco is harmful to the heart depends upon the individual's condition, and that can be determined only by his physician.

In all persons, smoking causes the heart to beat more rapidly. Any increase in heart rate may in time weary the heart by lessening the amount of rest between beats. In an individual with an already weak heart this might be injurious.

Also, in all persons, the "wind" is reduced after smoking. Athletes and physical trainers as well as physicians have noticed this fact. During regular athletic training, the use of tobacco usually is prohibited on that account. Experimentally it has been shown that in a cross country run open to smokers and nonsmokers, there are more smokers in the last 10 than in the first.

It appears that part of the effect of smoking upon the "wind" is due to carbon monoxide in the smoke, creating a mild degree of anoxia. In conditions when oxygenation of the blood is difficult at best, as in athletic feats and flying, the anoxia from smoking adds appreciably to the difficulty.

Nicotine and the Blood Vessels. The effect of tobacco upon the blood vessels is that of constriction.

Constriction of blood vessels can be demonstrated by special apparatus to measure skin temperature of the fingers and toes, which drops from 1 to 1.5° C. after smoking. It can also be demonstrated by photographing the visible capillaries in the retina of the eye.

Such constriction throughout the body raises blood pressure temporarily, especially in those whose blood pressure already is high. If smoking were continuous, the blood pressure would be kept constantly elevated and might produce the same organic effects as high blood pressure from other causes. If disease of the arteries were present, even a temporary increase of blood pressure might contribute to their rupture.

It appears that tobacco has a more marked effect in raising blood pressure in some than in others. The susceptible appear to have an idiosyncrasy to tobacco, and to them its use would be a special danger.

One of the symptoms of excessive smoking is pain under the sternum. It is not known whether or not this pain indicates constriction of blood vessels of the heart, but in any case it should be investigated. The great increase in deaths from blood vessel disease has coincided with the great increase in the use of tobacco, and some authorities believe that there may be some connection between the two.

Smoking Affects the Digestive Tract. Most people are made sick the first time they smoke, and some continue to be susceptible to the same symptoms from tobacco. The effects are partly local, through swallowing nicotine-laden saliva, but for the most part they appear to be due to disturbance of the sympathetic nervous system by nicotine that has been absorbed from mouth or lungs. The symptoms are those of mild or even marked indigestion. Physicians often find that a tendency to "indigestion" cannot be overcome until the use of tobacco is curtailed or stopped. In those with stomach ulcer the lesion usually cannot be healed or kept healed if the patient continues to smoke.

Local Effects of Tobacco. In some, the effect of tobacco smoke is irritating to the tissues of the mouth, eyes, and air passages. Again, the effect appears to be that of constriction of blood vessels. These membranes usually are somewhat dried and thereby may be made more subject to other irritants. Various lesions in the mouth are more common in smokers (e.g., one type of receding gums). It is thought that certain white spots, called leukoplakia, are often due to smoking. These have been known to become malignant. Statistically, however, there is little

evidence that cancer of the mouth, tongue, lips, or upper air passages is more common in smokers than in nonsmokers.

The situation may be somewhat different in regard to the lungs. There has been a marked increase in lung cancer, especially in younger people and in the female sex. This increase has paralleled the increased general use of tobacco and the particular increase of its use by women. That there is some correlation between these facts is strongly suggested.

As has been shown, the smoker may gain the impression that smoking is soothing to the nerves. Virtually no other benefit is ever claimed for it, and that appears to be doubtful. The claim is made chiefly by those whose irritability has been increased by previous smoking. Probably no physician has ever found it necessary to prescribe the use of tobacco by a nonsmoker or the use of more tobacco by a smoker.

Conclusions Regarding Smoking. From the foregoing facts it might well be concluded by the nonsmoker that he should remain one and by the smoker that he should cease to be one. If the latter decision is reached —and most smokers do reach it frequently—it can be carried out; it is possible to stop smoking and to do so abruptly. One method consists of stopping for one hour, and at the end of that time not smoking but postponing it for another hour, and so on. Denial becomes less difficult every day, and in a few weeks not difficult at all.

It appears to be easier to do without tobacco than to keep within the bounds suggested by one medical committee as safe for the majority—that is, to smoke only four or five cigarets or one cigar a day and to do so only after meals.

Part 3

Major Health Problems in the United States

12

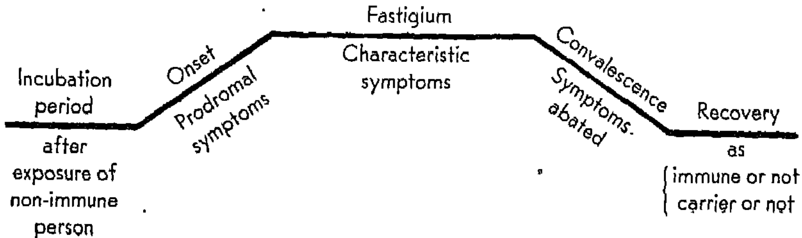
Problems of Communicable Diseases

General Considerations

A disease is called communicable (or transmissible or infectious or contagious) if it is a germ disease always due to the same type of germs; always causes similar characteristic symptoms, although not necessarily all the symptoms in every case; does similar damage to the body, although not necessarily equally extensive or serious in all cases; is likely to run a characteristic course; and spreads from the infected person (or animal) or from a carrier of the germs to the hitherto uninfected by typical kinds of direct or indirect contact, with, in some cases, typical intermediate animal or insect hosts.

Many communicable diseases spread so readily that they often cause epidemics, and for this reason are called epidemic diseases.

Control of Communicable Diseases. The control of communicable diseases is an important part of official health work. The law requires that the physician or attendant report every case of any of these diseases to the local department or board of health, which then takes such steps as are necessary to prevent other cases from occurring, to make sure the sick person has proper care, and to make sure that carriers are not at large in the community. In addition, departments of health do the utmost to keep the environment free of the germs of these diseases.



Course of a communicable disease.

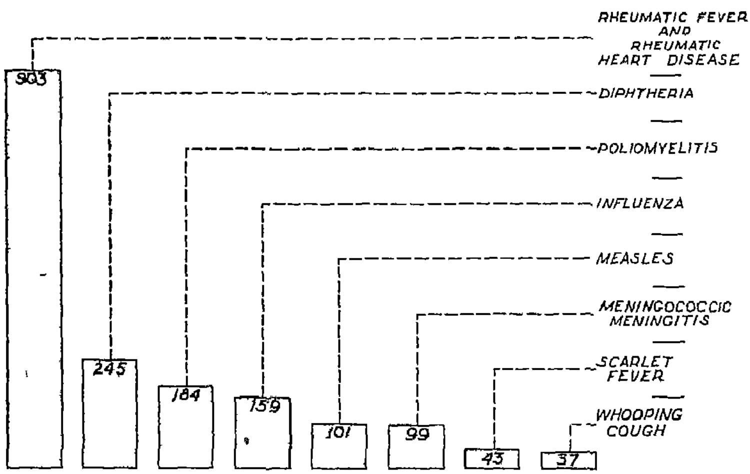
Governmental agencies employ epidemiologists, sanitarians, public health nurses, and members of many other professions to use scientific methods for protecting communities from any and all sorts of communicable diseases. Many of the methods will be indicated in reference to the specific diseases mentioned in this chapter.

What Use Is Made of Isolation and Quarantine? Isolation is applied to persons who themselves are infected and in a condition to infect others. Quarantine is applied to persons who are not themselves ill, but are in association with the ill, and therefore might carry infection.

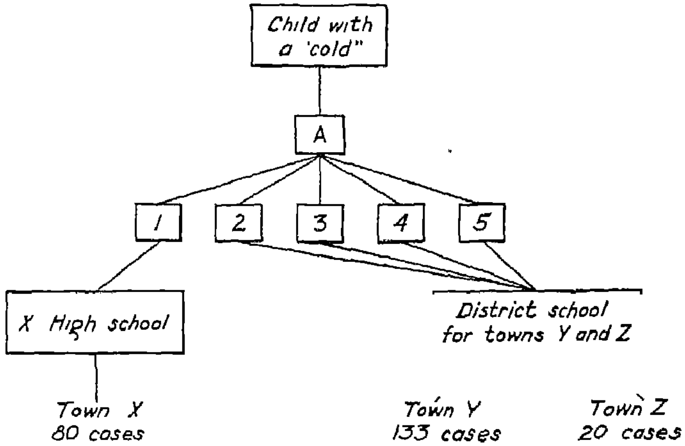
Those who are fully isolated must remain by themselves, except for medical and nursing attendants. Those who are fully quarantined must remain in specified premises, usually their own homes; but responsible adults often are allowed to go to work under certain specified conditions.

A person who has been exposed to a communicable disease, often is a danger to others before the first symptoms of the disease appear, during the incubation period. Such a person must either be isolated after exposure (if he is not immune) or he may be kept under twice daily observation during the time when he might be expected to become infective (an interval computed by adding the shortest incubation period to the date of the earliest exposure, and the longest incubation period to the date of the latest exposure).

Similarly, a person may still be a danger to others after the symptoms



Total deaths reported in the United States in 1947 among children 5 to 14 years of age from eight infectious diseases of childhood.



A boy "A," has contact outside his home with a child having a "cold." He develops measles. During the prodiomal stage he infects five other children in the family. These five go to school during the prodromal stage. In all, 239 cases arose from the early cases, none of which were suspected and isolated during the early infective period.

of the disease are over, that is, during convalescence, hence he must be isolated until medical tests pronounce him safe for release.

All matters concerning isolation and quarantine are governed by state and local law, and enforced by the police power of health departments.

Concurrent Disinfection. During any communicable disease, all infective secretions and excretions from the patient must be destroyed at once, and articles used in the sickroom must be disinfected or disposed of when taken from the room. This is known as concurrent disinfection.

Terminal disinfection of premises is to be carried out according to rules of the local department of health. Sun, air, and soap and water are the measures used most often. Fumigation has less germicidal value against most bacteria. (See section on destruction of germs in Chapter 9.)

Specific Problems. From 40 to 50 communicable diseases are notifiable to departments of health in most of the states and cities of the United States. Most of these will be discussed in this chapter.

The first three groups contain the communicable diseases which are the largest causes of death in this country. In the other groups, some diseases are mentioned that are important for the same reason; some that have been important in this country in the past and could be so again if preventive methods were relaxed; and others that are unim-

portant in this country, and presumably will remain so, but that have been included here in order to complete the picture of the communicable disease situation. A few others are mentioned in other chapters.

Pneumonia, Influenza, and Tuberculosis

Pneumonia. Pneumonia causes far more deaths than any other communicable disease. In fact, pneumonia and influenza rank sixth among all the causes of death. Since 1937, however, there has been a 50 per cent decrease in the death rate owing to new forms of treatment.

Lobar pneumonia, commonly called simply pneumonia, is an infection of one or more lobes of one or both lungs. It is due to specific organisms, the pneumococci, of which there are 32 known types. Any given case of pneumonia will be due to one type predominantly.

As a result of infection, the air sacs fill with serum and pus which consolidates the infected area; no air can enter, and the patient suffers from lack of oxygen. Toxins are formed and are absorbed throughout the body, giving a profound degree of illness.

The first symptoms of pneumonia usually are a chill, fever, and cough. Commonly, it is a short, sharp illness, with a long convalescence during which the damaged lung restores itself to normal.

Susceptibility to pneumonia is general, but more marked in men than in women. It appears to be increased by extreme exposure to cold, or any exposure which causes chilling. When laboratory rats are inoculated with pneumonia germs, only 10 per cent of those kept in the usual environmental temperature, but 50 per cent of those just previously exposed to cold, take the disease. Among humans, also, sudden changes from warm to cold appear to increase susceptibility.

Alcohol in the system reduces resistance to pneumonia. Rats rendered immune to it become susceptible again under the influence of alcohol. Among humans, the pneumonia death rate is high among alcoholics. The effect of ether anesthesia is similar somewhat in predisposing to pneumonia.

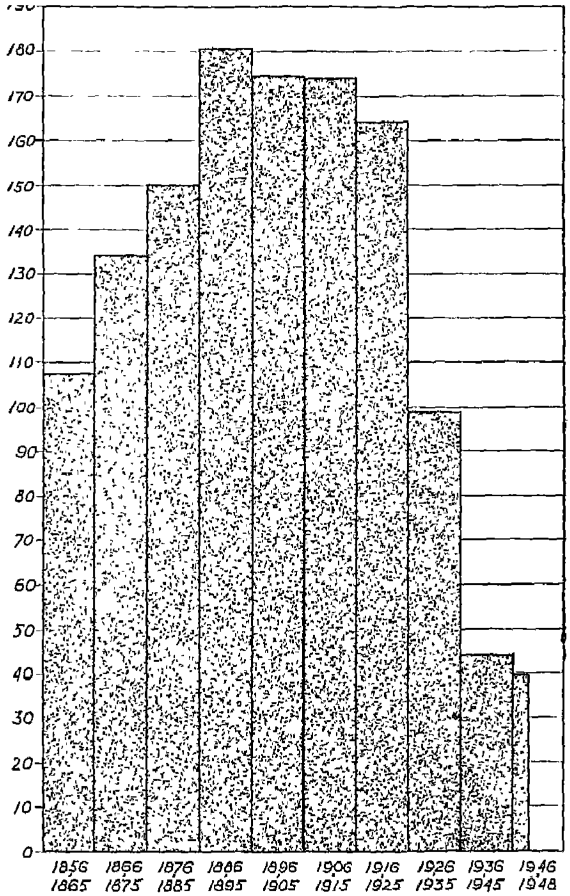
A large proportion of cases of pneumonia occur within a few days after the onset of a cold.

Prevention of pneumonia is by keeping general resistance high, avoiding contact with germs from the respiratory tract of others, and avoiding sudden or too great chilling.

Treatment of pneumonia is by penicillin or by a sulfa drug. There is a specific serum for each specific type of pneumococci involved, and in

some cases serum is used. It is thought that if treatment could be given early enough nearly every case could be cured.

Bronchopneumonia is due more often to germs other than pneumococci, and often is secondary to other infections or illnesses. It is particularly common and serious in infants, the aged and the bedridden.



Pneumonia decline in Massachusetts per 100,000.

Several types are highly communicable and occur in epidemics. Among these may be mentioned a type called atypical pneumonia, or virus pneumonia, its cause apparently being a virus as yet undiscovered; and the type which often follows influenza, though more often due to germs other than the influenza virus.

Pleurisy is an infection of the membranes covering the lungs. It may

occur by itself, but is frequently the accompaniment of lung disease, especially pneumonia and tuberculosis.

Influenza. Influenza is a specific communicable disease in which the lungs are often involved. It has a high mortality rate from the associated pneumonia. The cause is a virus, of which there are two types. The symptoms are chiefly systemic—fever, pain in the back and aching "all over," and a marked feeling of illness and weakness. There may or may not be symptoms of a cold. (The term "grippe" was first used to describe this disease, but at present it is used rather loosely for several sorts of infection, such as colds with aching.)

Individual susceptibility to influenza varies, and does not parallel susceptibility to colds. It appears that immunity to influenza sometimes occurs naturally. Vaccine for type A and type B influenza, if given before an epidemic starts, protects a large proportion of those vaccinated, and their relative immunity lasts from a few weeks to a year. Early fall vaccination is recommended. Since there is no specific treatment of influenza, special care is needed to recognize its onset. A person suspecting he may have influenza should go to bed at once, with medical attention, if fatal pneumonia is to be avoided.

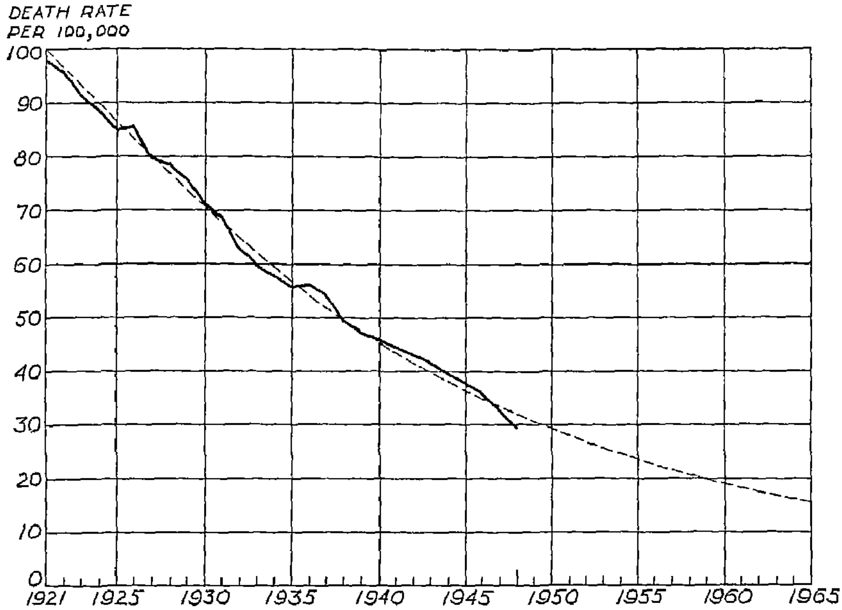
Tuberculosis. Tuberculosis is seventh on the list of causes of death, but it is the chief disease causing death among those 15 to 45 years of age.

Today, nearly all cases of tuberculosis in humans come from other humans, and the majority are lung tuberculosis. (Formerly bovine or cattle tuberculosis was very common in man. It often involved the bones and caused humpback and other skeletal deformities. Owing largely to the work of the Bureau of Agriculture, tuberculosis in cattle has been practically wiped out; therefore it is now rare in man.)

Infection often occurs in infancy, at which time the disease also may occur, but the germs often remain walled off and quiescent for years, and perhaps for life. This first infection sensitizes the system, however, so that the individual harboring germs is susceptible to reinfection, at which time the disease occurs.

Reinfection may occur from one's own previously quiescent germs. This is likely particularly in those depleted by excess of work, play, and emotion, or by deficiency of food, rest, and sleep, or by disease (e.g., diabetes or an infection such as measles or pneumonia).

Reinfection may also occur as a result of germs newly received. This is likely particularly in those who are exposed repeatedly to germs given



Decline in tuberculosis mortality in the United States since 1921.

off from a person with tuberculosis, as in the close association of a household. Those who are not in good health are more susceptible, but even the well may be reinfected if sufficiently exposed.

Prevention of tuberculosis is by means of avoiding exposure, especially of children and young adults, to the germs given off by infected persons, and by keeping the general health good. In some parts of Europe a vaccine (BCG vaccine) has long been considered a successful prophylactic. Experiments with it in this country, were at first not encouraging, but in recent years, the vaccine seems more promising.

The early symptoms of lung tuberculosis are not definite enough to permit a diagnosis on symptoms alone. The following symptoms, however, should suggest the need for complete examination: loss of weight, loss of appetite, indigestion, fatigue or loss of "pep," a cough that "hangs on," a "stitch" in the side of the chest, feverishness in the afternoon, hoarseness or huskiness of the voice, a need for clearing the throat, spitting of blood, and sweating while in bed at night. All of these together might not mean tuberculosis, or one of them alone might give the clue for further examination.

The diagnosis of tuberculosis is definite when tubercle bacilli are found in the sputum, but this does not occur early, nor do the changed sounds which the physician seeks through the use of the stethoscope and percussion of the chest. The most valuable information in the early stages is furnished by x-rays. In many school and college groups, routine x-ray tests are done to discover early cases of tuberculosis.

Table 15

PREVALENCE OF TUBERCULOSIS AT VARIOUS AGE LEVELS, DIVIDED BY RACE, FOR 1947*

Age	*White*		*Negro*		*Totals*
	Male	*Female*	*Male*	*Female*	
1–14	63	87	73	123	373
15–19	296	468	289	570	1,720
20–24	717	1,078	663	1,024	3,612
25–29	988	1,221	651	940	3,896
30–34	1,206	1,200	675	653	3,801
35–39	1,605	1,132	727	522	4,049
40–44	2,147	894	783	386	4,265
45–49	2,497	716	694	331	4,302
50–54	2,817	696	741	249	4,563
55–59	2,897	670	496	165	4,280

* Vital Statistics of the United States—1947.

In some groups, tuberculin tests (von Pirquet or Mantoux) are done to determine whether infection has ever occurred. A person who has ever taken in any tubercle bacilli will have a positive tuberculin test (i.e., the skin reacts in a given way to tuberculin applied on a scratch). Those who react negatively can be dismissed from consideration, as they certainly do not have the disease if they have never been infected. Those who react positively have had the first infection, and may or may not have the disease. Therefore, x-ray examinations of the chest are done to determine whether the disease is present.

In the large majority of positive reactors the lungs are found to be sound. These, as well as the negative reactors, are safe at the time, but

all persons should be retested at least annually up to 25 years of age, and occasionally as a routine thereafter.

When preliminary tuberculin tests are omitted it is on the assumption that the majority will be positive reactors and need to be x-rayed in any case, and it seems simpler to x-ray the entire group. Such a procedure also has the advantage of disclosing any other chest abnormalities that may be present.

Recovery from tuberculosis is likely if treatment is begun very early, i.e., when no symptoms have appeared, and the diagnosis is made by x-rays. The chances at that time are better than four in five, but if the disease is discovered later and treatment not begun until later, the chances are only one in five.

The treatment of tuberculosis has long been chiefly by hygiene; it consists of rest, plus a nutritive and abundant diet. For the sake of the patient and the protection of those in his home, treatment is best carried out in a sanatorium.

Today part of the treatment in many cases of tuberculosis consists of a surgical procedure known as artificial pneumothorax. Air is introduced into the pleural cavity, which has the effect of deflating the lung. This gives the lung complete rest for a time, until it gradually fills again with air. The process is often repeated many times at intervals, before recovery occurs. Occasionally, persons having this treatment may remain at home and at work rather than go to a sanatorium.

As yet no drugs have been found curative of tuberculosis, but hope has been aroused by recent successful experiments in treating tuberculous laboratory animals with streptomycin. Its value in human beings has not yet been fully assessed.

Syphilis and Other Venereal Diseases

Syphilis. Syphilis is one of the most common and serious diseases in the United States. The Public Health Service has stated that at any given time 6,500,000 men, women and children, or 1 in 20, have the disease. In some groups, 1 in 3 are infected. In others, notably college groups, the rate may be as low as 1 in 500.

The mortality from syphilis in the United States is estimated to be 100,000 annually, although comparatively few of these are recorded as due to syphilis, the rest being recorded as due to other causes (e.g., heart disease due to syphilis often is recorded as heart disease without mention of syphilis). In 1948 the mortality rate for syphilis was 6.3 per 100,000

The tiny corkscrew-like organism in this picture is the spirochete, or syphilis germ, as seen under the special "dark-field" microscope. Its average length is only 3/10,000 of an inch, or approximately the diameter of a red blood cell, its thickness is approximately 1/100,000 of an inch. (Courtesy, U.S. Public Health Service)

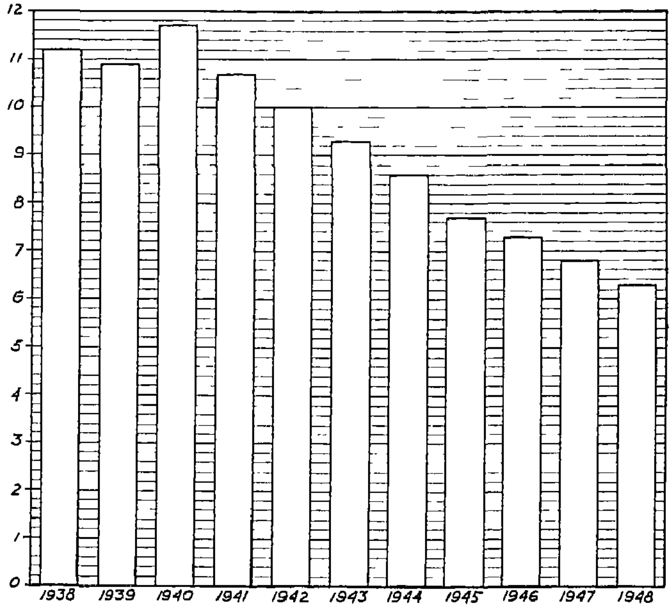
population in the United States. The syphilitic has a shorter expectation of life than the nonsyphilitic, for which reason insurance companies require an extra premium from them.

The disease begins, after an incubation period of 10 or more days, as a local lesion, called a chancre, located wherever the germs enter It varies in appearance from a small pimple to an ulcer somewhat resembling a "cold sore." In the female, this may be in a location where it is not discovered. The chancre heals after a time, whether treated or not. But it is only the first stage of the disease. Oliver Wendell Holmes was the first physician to describe the various stages of this disease.

The second stage appears three to six weeks after the first. The symptoms may be slight or numerous. They include the following: small whitish sores known as mucous patches inside the mouth, a rash, sore throat, fever, loss of hair, small flat warts on the genital organs, pains in the bones and joints, and involvement of the eyes, the ears, or the meninges. Not all persons have all these symptoms, but the majority have the first and several others.

The third stage is marked by the invasion of important organs. It occurs in those who have not had adequate treatment. The symptoms are those of the organ or organs involved. Often the cause of the symptoms is not apparent until a blood test reveals it.

The late third stage, or fourth stage, as it is sometimes called, appears



Syphilis decline from 1938–48

years later (5 to 30 years). The end result of the destruction that has been going on finally is shown, especially in the circulatory system (as disease of the heart and arteries) and in the nervous system (as paresis, locomotor ataxia, etc.). It is reported that one-fifth of all heart disease, one-tenth of all mental disease, and one-seventh of all blindness is due to syphilis.

To prevent this entire sequence of events, or death at some stage along the way, syphilis must be discovered early and treated early. A large proportion of cases can be cured and will remain cured if proper treatment is begun in the first stage and continued long enough. The germs are at first local. In a few weeks they have spread through the entire body, and the chances of cure become proportionately less. It is estimated that not more than 3 per cent of cases come under treatment during the first 10 days, and that not more than 1 in 250 needing treatment is actually receiving it.

The diagnosis of syphilis is made during the first stage by dark-field microscopic examination of serum from the chancre. A blood test, such as the Mazzini, Wassermann, Hinton, or Kahn, is not used at that stage, for it is a test of antibodies, and these are not present in the blood until two to three weeks after the chancre appears.

The disease is communicable to others from the lesions of the first and second stages, from the blood as long as the organisms are present, and from open syphilitic lesions at any stage.

Aside from intrauterine infection, by far the largest percentage of syphilis is acquired through sex relationships. Contact with contaminated articles, such as drinking glasses, is an occasional source of infection. So also is kissing. The latter possibility was noted as far back as the sixteenth century. A leading authority has estimated that in about 5 per cent the first lesion of syphilis is in the region of the mouth.

Prevention of syphilis is by avoidance of exposure, chiefly by the avoidance of illicit sex relationships. It is safe to assume that all the sexually promiscuous become infected sooner or later. Local prophylaxis cannot be relied upon fully.

For a generation the standard method of treating syphilis consisted of weekly injections, for a period of 70 weeks without intermission, of an arsenic compound and a bismuth compound. Shorter methods of treatment by arsenicals—apparently equally successful when administered by an expert—were coming into use at the time when penicillin was discovered. Experimentation with the use of penicillin in syphilis soon showed that it brings a prompt cure in many cases. It has not been in use long enough, however, for the medical profession to be certain whether those cured by it will remain free from the disease. Any syphilitic patient who has apparently recovered, must be under medical observation for evidence of a relapse or late symptoms. Whatever the treatment, it must be thorough, for if syphilis has not been fully overcome, late stage symptoms may appear after a time, and at that stage cure

For demonstration purposes the Public Health Service maintains completely equipped trailers for the diagnosis and treatment of syphilis among the people residing in rural districts. The one above has operated successfully in three rural counties in Georgia. (Courtesy, U.S. Public Health Service.)

hardly can be expected. Even in the late stages, however, the progress of the disease can often be checked, and even some degree of improvement may occur, especially as a result of fever therapy. In most parts of the country, both diagnosis and treatment may be obtained virtually free through state and local departments of health.

Marriage of those who have had syphilis is not safe until cure has been established beyond doubt, for there is danger of transmitting the disease to the mate and the offspring. Over 60,000 syphilitic babies are born in this country each year, and many of these die during their first year of life. In addition, thousands of stillbirths annually are due to syphilis. Of those babies who do not die, many are crippled or maimed in body or mind. Nearly all of this havoc is preventable if the mother is treated properly during pregnancy. In many states, a premarital examination is required for both sexes, and in nearly as many states, a prenatal examination is required for all expectant mothers. Under these laws, at least one syphilitic woman has been sent to jail for marrying, infecting her husband and baby, and refusing treatment.

Syphilis is notifiable, but usually by number rather than by name, the name not being disclosed by the physician to the department of health unless it becomes necessary to trace the patient to make sure that he is continuing treatment until cured.

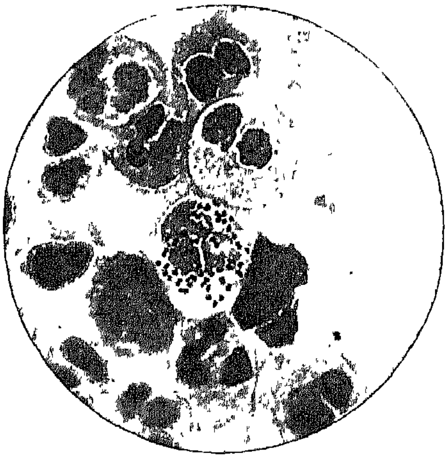
In 1936 a campaign against syphilis was started by the Public Health Service with the coöperation of the professions of medicine and public health. The methods consist chiefly of increasing the facilities for diagnosis and treatment, through cooperation with the states, and of educating the public regarding the menace of venereal diseases and the means whereby they can be prevented and cured. It is believed that this disease could be brought under control if the facts about it were more widely understood.

Gonorrhea. This disease is due to a germ of the pus-producing variety. It is acquired largely through sex relationships. Accidental infection through contaminated articles, though possible, is very rare. The incubation period is one to eight days. There is no immunity to the disease.

The first symptoms of gonorrhea are itching and burning of the urethra, usually with frequent and painful urination. Shortly, a discharge appears which may be watery at first, but soon becomes thick and whitish or yellowish. In the female, the discharge may be slight. Any such discharge, in male or female, should receive medical attention.

After a time the discharge may cease, even if untreated, but the germs

continue to live in the interior genital parts. The infection is likely to involve all the genital organs—in the male, the testes and the prostate gland especially; and in the female, the uterus and oviducts. When this occurs, abscesses may form. Local complications may lead to the need for surgical operations, either at the time or later. One of the common results of gonorrhea in either sex is sterility due to stricture (closing) of the ducts that carry the sex cells.



Gonococci in pus cells, as found in the discharge of gonorrhea.

From its original site, the disease may spread either by the blood or the lymph to remote structures. It may cause a general infection, "blood poisoning"; infection of joints, giving acute or chronic arthritis; infection of the heart valves; or infection of the eyes, if germs are carried to them on the hands, towels, and the like.

Gonorrhea is not transmitted to the infant in the uterus, but during birth the germs may be swept into the infant's eyes as it passes through an infected birth canal. The law requires the use of medicine in the eyes of every newborn baby, whether or not infection of the mother is suspected. This measure has greatly reduced conjunctivitis of the newborn, which was formerly a common cause of blindness.

The diagnosis of gonorrhea is made by finding gonococci in the discharge. Conversely, cure is gauged by no longer finding them, but it requires special skill to be certain that none lurk in any part of the genital tract or elsewhere. As long as any germs are being given off, the disease may be transferred to others.

Treatment for gonorrhea is by a sulfa drug or by penicillin, supplemented by fever treatment in some cases. Treatment should be begun at the earliest possible moment, before the infection has spread. At such a time, the outlook for complete recovery is good. Self-treatment is not safe, because the non-medical person has no way of testing to make sure that the infection is being overcome. There is danger that the individual who attempts to treat himself will take too little of the drug and thus not be cured, or too much, and thus be seriously poisoned. Only a physician can determine when a cure has been obtained.

Other Venereal Diseases. In addition to syphilis and gonorrhea, there are three other venereal diseases which are common among some classes of persons in some regions of this country. They are: chancroid, a venereal ulcer which usually remains local; lymphogranuloma inguinale; and granuloma venereum. The latter two, if untreated, may cause years of invalidism.

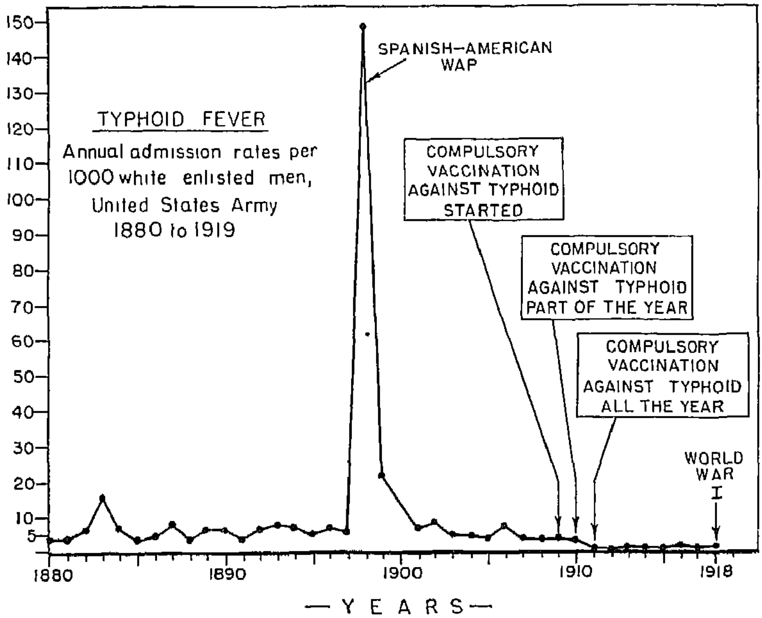
Typhoid Fever and Other Intestinal Infections

Typhoid Fever. Clinically, typhoid fever is a prolonged general disease, with diarrhea, fever, and usually considerable wasting. It is often fatal, although modern methods of treatment have improved the possibility of recovery. The germs are given off from the sick in the excreta.

Formerly one of the most serious public health problems, typhoid fever now is relatively unimportant among the communicable diseases as a cause of death. In 1947 it caused only 282 deaths in the United States. The reduced rate of typhoid fever has come about largely through municipal sanitation, which includes proper disposal of sewage, purification of water supplies, sanitary milk production and pasteurization, and protection of food supplies. In addition, vaccination against typhoid fever, begun before World War I, has proved highly effective for both military and civilian populations.

When typhoid occurs in cities today, it is traced usually to food infected by a carrier of the germs. Such a carrier may be a person who has had the disease recently, or at some time in the past, or who is not aware of having had it. Small epidemics traceable to carriers are not infrequent. General inspection of food handlers would help to solve the problem of typhoid and of lesser intestinal infections.

In rural districts, the most important source of typhoid is still a water supply contaminated by excreta not properly disposed of. Those who live in the country should see to it that their system of disposal of waste



Typhoid fever rates in the United States Army, 1880–1919. (Used by permission of the Surgeon General, U S. Army)

is sanitary and their water supply pure. County and state health officers can be called upon for advice and for testing of water.

Travelers in rural regions should not use drinking water about which there is any doubt without first boiling it or disinfecting it with chlorine, as by halazone tablets.

Present evidence favors vaccination against typhoid fever at least every two years, and oftener if special exposure is likely.

Paratyphoid Fever. This disease is somewhat milder than typhoid fever, but presents similar symptoms. It is transmitted in the same way, and is preventable by the same methods. Vaccines against types A and B paratyphoid fever are usually given with typhoid vaccine, the combined vaccine being called TAB vaccine In 1947 it caused only 43 deaths in the United States.

Dysentery. The symptoms, mode of transmission, and sanitary preventive measures of dysentery are similar to those of typhoid fever. One type of dysentery, amebic dysentery, is caused by a single-celled animal parasite, an ameba. Another type, bacillary dysentery, is caused by bacilli of various sorts. The latter is responsible for a considerable number of deaths in this country every year. Flies are particularly bad as

In a fly-control program, a public health worker applies D.D.T. in a dairy barn. (Courtesy, Communicable Disease Center, U.S. Public Health Service.)

spreaders of bacillary dysentery, and too much cannot be said as to the necessity of preventing access by flies to either raw sewage, or to food or the person. During the last war, wholesale spraying with DDT sharply cut the incidence of bacillary dysentery.

Food Infection and Poisoning. Several varieties of bacteria or bacterial toxins in food may be responsible for short, sharp "digestive upsets," with diarrhea, weakness, and perhaps abdominal pain, vomiting, and fever. Popularly, such attacks are often called "ptomaine poisoning," or, when fever is present, "intestinal flu." These attacks usually are not serious, and subside quickly if no food but plenty of water is taken. In infants, however, many deaths occur from this cause. Since the more serious gastrointestinal infections may begin in the same way, any attack which lasts more than one day, and any attack which is especially severe, should receive medical attention.

The bacteria may be already in food when purchased, as in meat not government-inspected. Or they may enter food in provision shops and homes, from the excreta of rats and mice, or from excreta-contaminated hands of humans.

Food sanitation in the home includes:

1. Buying food only from safe, reliable sources.
2. Storing perishable food at a temperature constantly below 50° F.
3. Thorough washing of all foods to be eaten raw.
4. Thorough washing of hands before handling food.

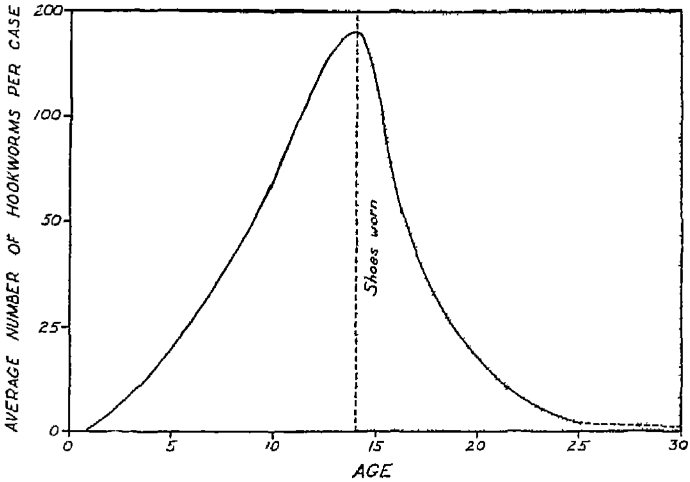
5. Using only clean utensils.
6. Keeping food inaccessible to rodents or insects.

Botulism. Botulism is a specific food poisoning due to the toxins of the Bacillus botulinus. It does not cause diarrhea, but affects the nervous system. The first nerves to be involved may be those of the eyes. The disease usually is fatal, causing death by paralysis of the nerve center for respiration in the brain. Cases are seldom traced to any food except home-canned nonacid food; such foods should be boiled 15 minutes immediately before they are used. The toxin does not change the appearance, odor, or taste of food containing it.

Trichinosis. This is a worm infestation of hogs, to which man is subject. Several million persons in the United States are said to be infected through having eaten undercooked pork products. Since pork products cannot be guaranteed free from the organisms, trichinellae, the only protection against the disease is by refraining from eating pork products that have not been thoroughly cooked during commercial processing or in kitchens. This applies to pickled or salted, as well as to fresh, products.

Hookworm Disease. This disease is due to parasitic worms which establish themselves in the intestinal tract. The eggs are given off in the excreta of the infected persons, and develop to embryonic stages in the soil, remaining viable. The young worms enter the body through the skin of the feet in those who go barefoot in contaminated soil, or through the mouth, by means of contaminated water, food, or hands. The disease prevails where sanitation is primitive and soil is sandy. In some southern counties, 12 to 30 per cent of white persons are infected, but fewer Negroes who apparently are partially or wholly immune. The symptoms are chiefly anemia, weakness and mental sluggishness. Stunting of growth occurs if it begins in childhood. The Public Health Service and the Rockefeller Sanitary Commission have labored since 1901 to prevent new cases by curing existing ones, and by providing for proper disposal of sewage and the wearing of shoes. The incidence of the disease is constantly decreasing.

Undulant Fever. This disease, sometimes called brucellosis, is a disease of animals, especially cattle, goats, and swine, to which man is subject. It occurs largely among those who work with infected animals, although cases have been traced to unpasteurized milk of cows or goats. Many states are coöperating with the federal government in eliminating infected animals, especially in dairy herds. Those particularly exposed to the disease may be vaccinated against it. The symptoms are prolonged



Intensity of hookworm infestation in a large group examined in a southern state. Increase up to age 14, decrease thereafter. Children under 14 customarily did not wear shoes in the summer, whereas older children and adults wore shoes the year round.

slight fever, with much weakness. In some cases, the disease is fatal.

Infectious Hepatitis. This disease was known formerly as catarrhal jaundice, or epidemic jaundice. Sporadic cases occur, but it occurs most often as small epidemics. The disease is due to a virus which affects the cells of the liver. The symptoms are jaundice or yellowing of the skin and the white part of the eyes, and gastrointestinal symptoms. Usually it is not a severe disease, but sometimes a chronic condition of the liver continues. The causative organism has not been identified, and the precise mode of transmission has not been established. It is apparently transferable from person to person, and it is suspected that some cases have arisen from infected serum (e.g., after immunization for yellow fever). Gamma globulin, a fraction of blood serum, is useful as a preventive in epidemics.

Infectious Jaundice. This disease, also known as icterohemorrhagic jaundice, or spirochetal jaundice, is due to a spirochete, and is not the same as infectious hepatitis mentioned above. It is very rare in the United States, but is more common and more severe in the warmer countries. Most often it appears to be due to taking food or water contaminated by the excreta of the brown rat. Prevention is by protecting food from rats, and by thorough cooking of food.

Cholera. Cholera is a severe intestinal infection which no longer occurs

in this country, although within a century its prevalence was responsible for the organization of the first departments of health in cities. Epidemics still occur in Asiatic countries that lack respect for sanitation. Cholera is transmitted by the same routes as typhoid fever, and is preventable by the same sanitary methods. Vaccine is of great value in cholera regions, and to persons traveling to such regions, even though immunity is not absolute and lasts only a few months.

In 1945, a successful method of treating cholera by injection of blood plasma and saline solution plus a sulfa drug, was reported.

Infantile Paralysis and Other Infections of the Nervous System

The common name of the disease poliomyelitis, "infantile paralysis," is not very satisfactory, for there may be no lasting paralysis and the disease is not confined to infants. It is a disease due to a filtrable virus which attacks nerve cells, chiefly those in the spinal cord supplying motor impulses to the muscles of the extremities, most often the legs. Occasionally the act of breathing is handicapped.

Table 16

ACUTE POLIOMYELITIS COMPARED WITH SIX OTHER DISEASES FOR THE YEARS 1939 AND 1949*

(DEATH RATES PER 100,000)

Disease	*1939*	*1949*
Acute poliomyelitis	.5	1.7
Cancer—all forms	100.6	113.1
Tuberculosis—all forms	44.8	24.1
Communicable diseases of childhood	4.0	1.0
Heart—all forms	312.9	304.0
Influenza and pneumonia	51.4	19.5
Diabetes mellitus	27.0	24.8

* Source—Statistical Bulletin, January, 1950, Vol. 31, No. 1.

The disease usually begins with minor symptoms such as a sore throat, digestive upset, or pain in the abdomen or extremities. There is slight fever and headache, and the patient will be unwilling to bend forward his head or spine. Paralysis or muscle weakness comes on in one or

two days. It is usually at its worst at the start, and nearly half of the paralytics recover entirely. Proper treatment of the weakened muscles makes a great deal of difference in the ultimate result. Usually, deformities can be prevented to such an extent that the patient will be able to walk, although perhaps requiring braces or crutches. Convalescent serum does not appear to be useful in treatment.

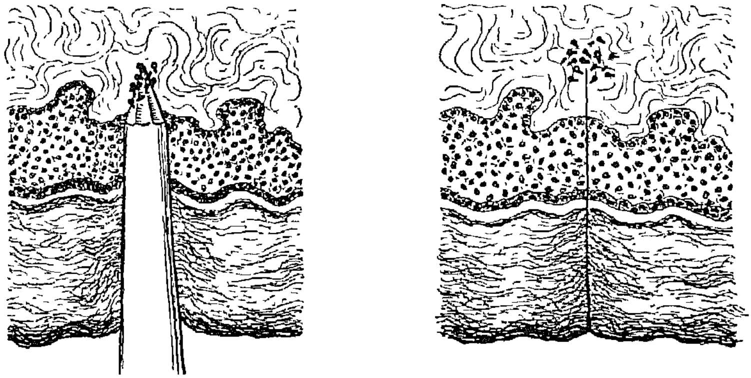
It is not known precisely how poliomyelitis is spread. At the time of an epidemic, any direct or indirect contact with those who have the disease or have had it within a few weeks, and with those closely associated with the ill, should be avoided. It also includes, as at all times, avoidance of any of the common ways of taking infection.

No specific preventive measure effective in human beings has been discovered. Not all people are susceptible, possibly because they have become immune as a result of repeated exposure to a strain of virus not strong enough to make them ill, or possibly because of some type of natural immunity.

Cerebrospinal Meningitis. This is a specific inflammation of the meninges (membranes covering the brain and spinal cord). It is due to germs called meningococci that are transferred from a case, or, more often, a carrier. It begins with headache and symptoms of a cold, stiffness of the neck appearing later. If treated promptly (by serum, a sulfa drug, or penicillin) the chances of recovery are good. (Meningitis due to germs other than the meningococcus may occur secondary to other infections, as, for example, of the ear.)

Epidemic Encephalitis. This disease popularly known as "sleeping sickness" is an infection of the brain. The mode of transmission is presumably by contact with nasal secretions of an infected person or carrier, or, in one type, by an insect vector from an infected horse to man. This disease should not be confused with the sleeping sickness common to parts of Africa and caused by a protozoan parasite transmitted by certain flies. (See page 200.) (Nonspecific, noncommunicable encephalitis may occur secondary to infection elsewhere in the body.)

Rabies. A disease occurring chiefly in dogs, transmitted to man by a bite. In some states every dog bite is notifiable. Not all persons bitten by a rabid animal take the disease, but if they do they will die unless the Pasteur prophylactic treatment is begun promptly enough. This treatment must be given unless it can be proved that the animal was *not* rabid. To prove that, the animal must be under observation from seven to ten days; if it does not develop the disease in that time, the person bitten



(*Left*) Tetanus organisms being carried into the tissues. (*Right*) Nail has been withdrawn, edges of the skin have come together, leaving bacteria in the skin and shut away from the air.

is safe. It is important to secure such proof, for after a bite, unless such proof is available, the treatment must be given and it is long and expensive and not without some danger.

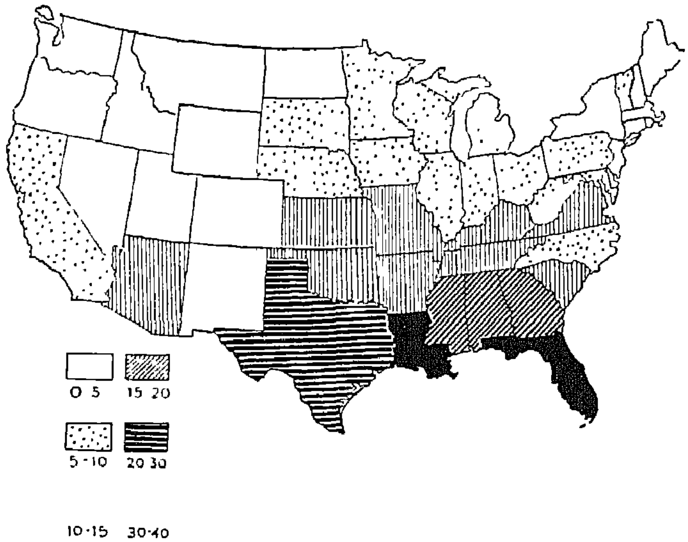
Public health measures to prevent rabies consist of licensing dogs, doing away with stray dogs, putting imported dogs into quarantine, restraining or muzzling of dogs in infected communities, and vaccinating of dogs.

Nail, carrying tetanus organisms, entering foot.

Tetanus. This disease is popularly known as lockjaw because it causes painful contractions of the jaw and neck and later of the rest of the body. It is caused by organisms that enter the soil from the excreta of animals and later enter the skin through wounds contaminated by soil, especially through penetrating wounds that furnish the airless medium the germs prefer. The toxin then travels along nerves to the brain. Toxoid is used as a means of raising resistance to tetanus; antitoxin is used for prevention at the time suspicious wounds are received. Antitoxin is used in treatment of the disease, should it occur. Some cases recover.

Malaria and Other Insect-borne Diseases

Malaria. It is estimated that three and a half million deaths from malaria occur annually throughout the world. Possibly one third of the



Average annual deaths from tetanus per million population based upon the years 1933, 1934, and 1935, and the official 1930 populations. (By permission of *Surgery, Gynecology, and Obstetrics.*)

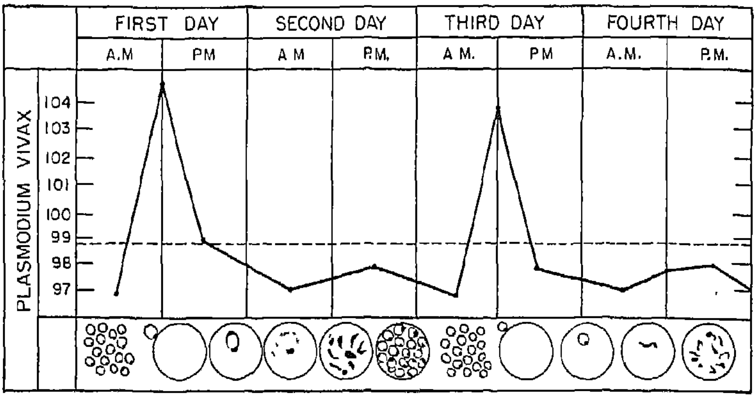
world's population is infected. It not only kills but causes chronic illness and predisposes to other diseases. In this country, it prevails to some extent in regions having a warm climate, favorable to mosquito life.

Malaria is transferred from person to person by the bite of the anopheles mosquito. The disease is marked by chills and fever occurring daily, every second day, or every third day. The parasite destroys red blood cells, causing anemia.

Prevention of malaria in a community consists of destroying the breeding places of mosquitoes by the use of oil on the surface of ponds and the like, and by cutting out weedy marginal growth; using fine-mesh wire screens at doors and windows to keep mosquitoes away from both sick and well; killing larvae in breeding waters or adult mosquitoes in resting places by spraying with insecticides such as DDT; and curing existing cases of malaria by the use of quinine, atabrine, or other antimalarial drugs.

Individuals in malarial regions are given antimalarial drugs for prophylactic purposes, to prevent the disease from appearing if they should be bitten by malaria mosquitoes.

Those who have had the disease may have relapses. They should be



Relationship of development of malarial parasites to the fever in malaria. (From Therapeutic Notes, courtesy of Parke, Davis and Co.)

under medical supervision to make sure that their blood remains free from the organisms. This is both for their own sake and for the sake of others.

Typhus Fever. This disease was formerly confused with typhoid, chiefly because of the stuporous condition that prevails at the height of the disease. The epidemic type of the disease is louse-borne, from man to man. It is largely a disease of wars. In World War I, typhus killed 8,000,000 soldiers and civilians in Europe and Asia Minor. In World War II, typhus was epidemic among civilians in certain areas, but virtually no cases occurred among the allied forces. It was prevented, first, by vaccination against it, and, second, by sanitary measures, including particularly the use of the insecticide DDT in the clothing and on the persons of those exposed to lice.

Endemic or murine typhus fever occurs occasionally in this country. It is flea-borne from rats to man. Anti-rodent work is the chief measure for keeping it under control.

Scrub typhus, or tsutsugamushi fever, is a disease not seen in this country although of frequent occurrence in Japan and the countries of the South Pacific. It is mite-borne, the principal reservoir being various wild rodents. The illness is often serious and prolonged, but seldom fatal. Prevention is by measures to avoid contact with mites. Certain insecticides, although not DDT, are effective.

Tularemia. First recognized in this century, tularemia is a disease primarily of rabbits and other small animals. It is transmitted to man by the bites of blood-sucking insects (wood tick, dog tick, and horsefly)

that feed first on infected animals. Also, it may be acquired by eating undercooked flesh of infected rabbits and hares, and even by handling such animals while skinning or dressing them. Apparently the disease is not transmitted from man to man. Recovery takes place unless complications such as pneumonia arise.

Rocky Mountain Spotted Fever. First recognized as recently as 1899, this disease has spread widely from its original habitat since 1930 and now occurs in nearly all states. It is transmitted by means of ticks, chiefly from rabbits, woodchucks, field mice, and dogs. Although the disease is often fatal, the majority of cases recover, and without after-effects, if treatment is prompt and thorough. The study of this disease is one of the important interests of the Public Health Service's Rocky Mountain Laboratory.

Prevention consists chiefly of the wearing of tick-proof clothing on the feet, ankles, and legs up to the knees when walking in tick-infested fields and woods; and a nightly examination of the body and clothing for ticks. If ticks are found, they should be removed without touching them with the bare hands and without crushing them. Tweezers, or a thick piece of paper, should be used, and the tick should be burned at once. Dogs exposed to ticks should be similarly inspected. If ticks are not readily detachable, a physician or a veterinarian should be consulted.

In tick-infested regions, local departments of health will furnish further details regarding protection against ticks and their removal, as well as regarding diagnosis and treatment of the disease.

Colorado tick fever, prevalent in Colorado and nearby states, is believed to be a separate disease transmitted by another variety of tick.

Relapsing Fever. This disease is tick-borne in this country although louse-borne in Europe and Asia. The few cases in this country occur chiefly in some of the western states, where it is perpetuated by small animals such as squirrels and opossums which carry the infection. Recovery is the rule. Prevention is by avoiding tick bites.

Tick Paralysis. A progressive and usually fatal type of paralysis, this disease is due to infection introduced by a particular variety of ticks found in limited areas in the western part of this country and Canada.

Plague. A serious disease primarily of rats and squirrels, plague is transmitted to man through fleas. One form (pneumonic) is transmitted from man to man. Pneumonic plague is always fatal, and another form (bubonic) is frequently so. Brief artificial immunity may be secured by those expecting exposure. As a result of constant public health work,

especially in rodent control, scarcely a case has occurred in this country since 1928, although it still persists in the Orient.

Dengue. Another disease which occurs in this country but which is more common in the tropics is dengue, or "breakbone fever." The chief symptom is aching of the bones, with fever. It is carried by several kinds of mosquitoes, some of them the same as those carrying yellow fever. Other insect vectors are flies or gnats of the genus Phlebotomus, mostly in the tropics. Outbreaks have occurred in this country, chiefly in the South. After the acute attack, the individual remains weak for some time. The chief preventive method is mosquito control.

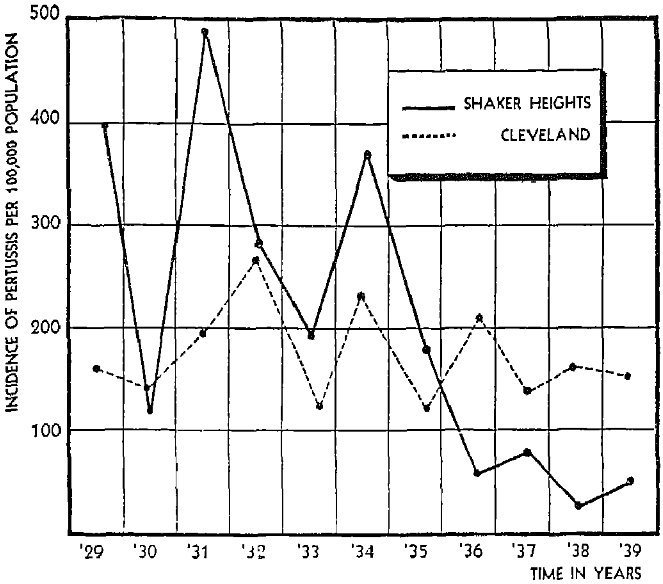
Filariasis. Filariasis is a worm infestation, transmitted by the blood-sucking insect vectors, chiefly by mosquitoes. It is known as elephantiasis because of the enormous swellings which occur when the parasites multiply in the lymph channels. Although the disease occurs in both hemispheres, it is extremely rare in the United States. Prevention consists of mosquito control.

Yellow Fever. The last epidemic of yellow fever in this country occurred in 1905. Major Walter Reed, U.S.A. Medical Corps, and his associates demonstrated at the risk of life (and at the cost of life to some) that it is spread by a particular kind of mosquito. Thereafter, through destroying the breeding places of these vectors, this country was made free of a disease which had invaded the eastern states 95 times and had cost tens of thousands of lives. The possibility of the mosquitoes reaching this country on airplanes from countries where it prevails, has renewed the threat of this disease and intensified the work of the United States Public Health Service at airports. A vaccine is available to protect persons who are to be exposed to the disease. Jungle yellow fever occurs in the tropics but has not been reported in the United States. It is still under investigation as to causes and vectors.

Other Insect-borne Diseases. In the warm climates, where conditions are favorable to insect life, a number of insect-borne diseases occur which have not yet made their appearance in this country. Some of them undoubtedly could become epidemic here, but are not likely to do so because the Public Health Service constantly takes precautions against that eventuality through its international quarantine measures and regulations.

Diseases Common in Childhood

Whooping Cough. Whooping cough, or pertussis, is placed first in this group because it is responsible for many more deaths than any of



Immunization reduces incidence of peitussis.

the others in the group. Fatalities occur most often in the very young, and usually are due to a secondary pneumonia.

The disease begins with a cough, which does not become "whooping" for about two weeks. In the meantime, the germs are present in droplets of saliva and may be spread to others. The illness continues and remains infective for several weeks.

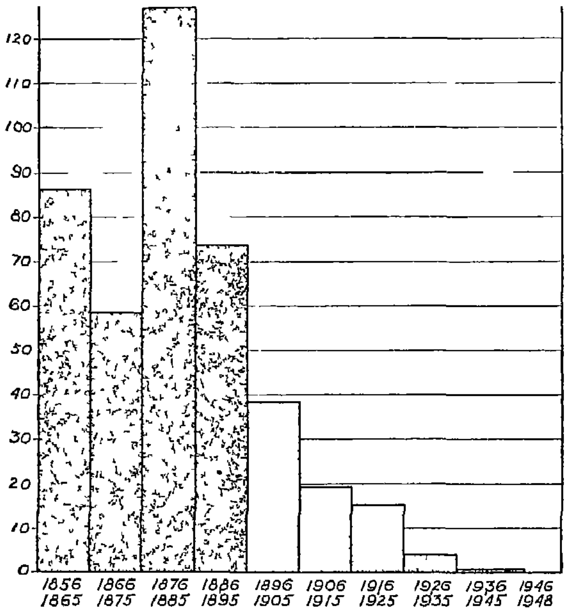
Pertussis vaccine protects against whooping cough. Serum may prevent an attack or lighten it if given after immediate exposure and before symptoms begin.

Diphtheria. The second largest cause of death in this group is diphtheria, and this is the case in spite of three definite measures of control: first, the Schick test to determine susceptibility; second, toxoid to create immunity; and third, antitoxin for treatment. Today, there should be neither cases of, nor deaths from, diphtheria.

The disease is characterized by a sore throat and systemic symptoms due to toxins produced by the germs. Diagnosis is confirmed by culture of the organisms in material swabbed from the nose and throat (or other lesions). The success of treatment by antitoxin is according to the promptness with which it is used. The decline in the death rate from diphtheria as soon as antitoxin was introduced is shown on p. 264.

Later marked declines are evidence of the wide use of toxoid for prevention.

Measles. Measles, or rubeola, is a disease marked by a rash, inflammation of the eyes, and often cough A common complication is pneumonia. After known exposure, prompt use of serum may avert or mitigate the attack, but this prevents the patient from developing his own antibodies and thereby becoming immune to the disease hence-



Decline of diphtheria in Massachusetts, 1856–1948, rate per 100,000. Note the marked reduction since the introduction of antitoxin

forth; therefore, in the case of a healthy child, serum may not be used, or its use may be delayed until after the attack has begun. An attack in a person under three years of age or over 25, should not be taken lightly, and even in adolescents, otitis media is sometimes a complication.

Scarlet Fever. Early symptoms of scarlet fever, or scarlatina, are a sore throat and rash. It is communicable to others before the rash appears, and remains communicable as long as the germs (hemolytic streptococci) are being given off. Complications are common (ears, kidneys, and especially heart). These are often serious and may lead to chronic disease. Immunity is indicated by a negative Dick test. Im-

munization is by antitoxin. Passive immunization after exposure may avert or lessen the attack For treatment, a serum, an antitoxin, penicillin, and sulfa drugs are available. Epidemics have occurred through unpasteurized milk.

Mumps. Since mumps involve the salivary glands in front of the ear, the parotid glands, the disease is called parotitis. These glands, on one side or both, become enlarged and painful. Often the salivary glands under the lower jaw are also infected. The sex glands, too, may be involved, perhaps causing sterility. Serum after exposure may prevent or lighten the attack. Because of the possible complications, mumps require medical care and usually bed rest.

German Measles. German measles, or rubella, is a mild disease, with a rash and enlargement of lymph glands behind the ears and in the neck Complications are few. It is a wholly different disease from measles, and because it is mild, can usually be taken casually, except in the case of a pregnant mother; here there is evidence that congenital defects may result in the child.

Chickenpox. A mild disease with rash. Complications are rare.

The Common Cold

A cold is an infection by a virus, often immediately followed by secondary infection by pus germs. When the latter occurs, the previously watery secretion becomes thick and whitish or yellowish The virus cold lasts from one to three days, but the bacterial sequel lasts two weeks or more.

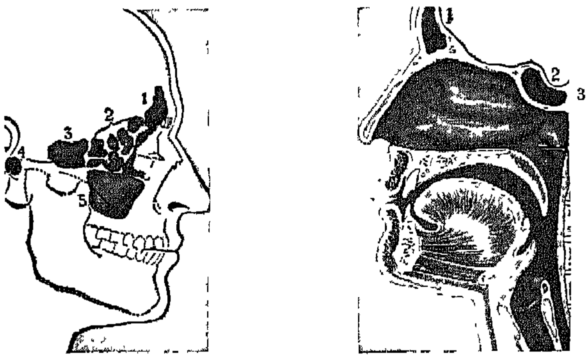
Colds are transmitted from person to person, largely by droplets given off from the nose and mouth in sneezing and coughing, and of course, by kissing. Contaminated hands and objects and the air in unventilated rooms, streetcars, and the like, which have been occupied by persons with colds, may be intervening vehicles of infection.

Although a cold in itself is not serious, many of its complications are. The infection may involve the sinuses, or any part of the respiratory tract, the eyes, the ears, and even remote parts of the body, such as the kidneys. Furthermore, a cold may aggravate existing infections in the body, or other illnesses. The most common serious sequel of colds is pneumonia.

Susceptibility to colds varies. Many authorities believe that good general health affords some protection. Predisposing factors appear to be overfatigue and chilling, especially at times when colds are prevalent.

Local predisposing factors are: an unhealthy condition of the mucous membrane of the nose and throat; chronic sinus infection; and certain atmospheric conditions (hot, dry air; cold, damp air; or a sudden drop in temperature).

Prevention of colds is by correction or avoidance of any of the predisposing factors mentioned; by avoidance of close contact with individuals having colds, especially in the first stage; and, if one's physician recommends it, vaccination against the secondary bacterial invaders.



The sinuses. (*Left*) (1) Frontal sinus. (2) Ethmoidal cells. (3) Sphenoidal sinus. (4) Middle ear. (5) Maxillary sinus. (*Right*) (1) Frontal sinus. (2) Sphenoidal sinus. (3) Orifice of the eustachian tube. (Courtesy, Denver Chemical Co.)

Maintenance of general health by correct eating, exercise, proper sleep, the taking of vitamins, etc., is probably an important preventive factor.

Treatment of a cold is bed rest until well, or until given permission by one's physician to get up. One day in bed may suffice if one goes to bed at the first symptoms, which usually are chilly feelings and a dry, irritated feeling in the nose and behind the soft palate. Three days in bed may suffice if one goes to bed when the watery nasal secretion becomes profuse and the temperature is raised. One who feels ill and has symptoms after one day or three days should not get up, however, for the danger of pneumonia is greatest on the third and fourth days.

Staying in bed helps cure a cold in two ways—it keeps energy expenditure at a minimum, and it makes regulation of body temperature easier so as to avoid chilling and its consequences. (Of course, it has the added advantage of keeping the individual away from groups through which he might spread his infection.) The use of the widely advertised, recently developed, medicines for colds is still not on a settled basis.

As for self-treatment of colds, it is desirable to take a warm bath and a warm drink before going to bed, but no self-prescribed medication. A doctor should be called (1) if temperature remains 100° F. for more than a few hours, or is rising; (2) if the throat or chest are at all sore; (3) if there is a cough; (4) if there is "stuffiness" or pain in the ears or if hearing is impaired; (5) if the glands in the neck enlarge; or (6) if any other new symptoms appear.

Precautions should be taken during recovery from a cold, for complication may arise at any time before germs are overcome entirely if overfatigue or chilling occur.

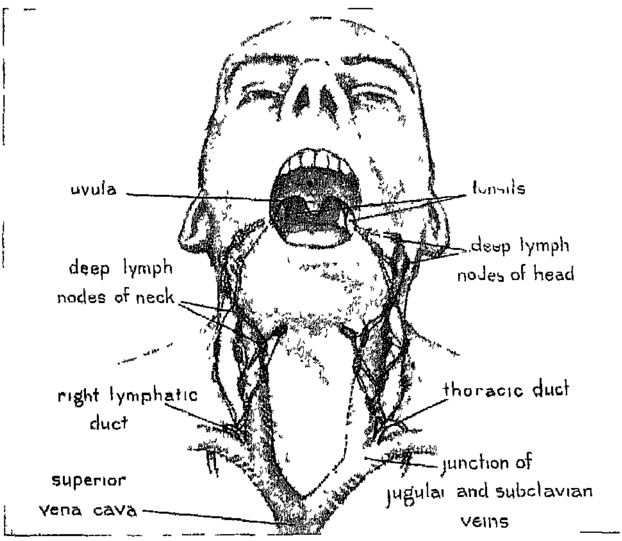
To protect others from one's own cold germs, one should voluntarily isolate one's self as completely as possible during the early stages. When mingling with others one must cover the mouth and nose completely when coughing or sneezing; must not sleep in the same bed, and preferably not in the same room, with anyone else; must not kiss anyone; must not talk directly into another's face; if possible must make sure that one's table utensils are sterilized before another person uses them; must use disposable tissue and dispose of it by burning; and must keep the hands as clean as possible and not touch the belongings of others with them.

The reporting of colds to health officers in colleges and similar groups is often required. This is for the protection of the individual and the group. To cite only one reason for such regulations, there are about a dozen epidemic diseases which at the start resemble a cold of nose, throat, or chest.

Streptococcus Diseases

There are several varieties of streptococci. The most dangerous is the hemolytic variety which tends to dissolve red blood cells. These are the cause of several communicable diseases.

Septic Sore Throat. This is a severe sore throat, or tonsillitis, often called "strep" throat. It occurs usually in epidemic form, although there may be isolated cases. The source of the germs is a human being who has the disease or is a carrier of the germs; or milk contaminated by such a person, usually in wholesale fashion, at a farm or dairy. The onset is often abrupt with a chill, and fever may run high. The complication most to be feared is damage of the heart. The glands of the neck often become enlarged and infected, with scars after healing. Prompt medical treatment is needed for any severe sore throat.



The tonsils and the lymphatics associated with them, to show the route of absorption of infective material or bacterial toxins into the circulation.

Erysipelas. An infection of the skin by streptococci. Wounds or abrasions seem to render the skin especially susceptible. The disease may follow severe sunburn. It is thought that the germs may reach the skin from the individual's own nasal cavity. Healthy adults usually recover, but in infants, the aged, and those already ill, erysipelas may be fatal. Among the complications are pneumonia and heart disease.

Other Streptococcus Diseases. One type of puerperal fever—the infection that formerly took the lives of many mothers in childbirth, and that still is of great importance—is due to streptococci. This disease is mentioned in Chapter 20.

Scarlet fever, described in a previous section, is due to hemolytic streptococci.

Rheumatic fever, discussed in Chapter 13, is often classed as a streptococcus infection, since these germs predominate in the throat at the time that rheumatic fever begins. It is not yet certain, however, that the disease is caused by them.

Miscellaneous Communicable Diseases

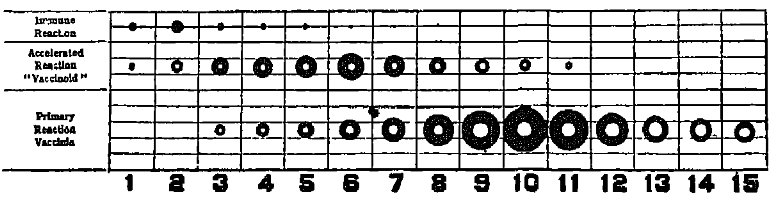
Smallpox. This is a disease beginning with fever, then in two or three days, a skin eruption of such severity that it often leaves the victim badly pitted or "pocked" with ugly scars.

Nearly 5000 years ago, smallpox was prevalent in Egypt, and it continued to be prevalent throughout the world until Edward Jenner discovered vaccination in 1798. Since then, vaccination has saved more

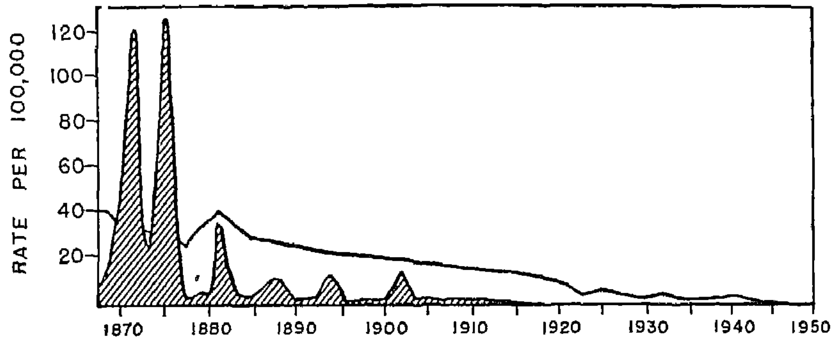
Edward Jenner (Courtesy, *Today's Health,* formerly *Hygeia.*)

lives than any other medicine or preventive measure ever used. Before that time, 95 per cent of persons had the disease, and a fourth died of it, the rest being pock-marked for life.

Vaccination is a safe and sure preventive of a loathsome and dangerous disease. There should be no smallpox in this country. The rate varies from state to state according to legal requirements regarding vac-



Three types of reaction to smallpox vaccination. Note that those who are immune have inconspicuous reactions. If vaccination is done in infancy and again in the 'teens, thereafter an immune reaction is likely when vaccination is repeated. Immune reactions are sometimes mistaken for "no take." (Courtesy, New York State Department of Health.)



Smallpox mortality rate by years in U.S. Registration Area (line) and in New York City having compulsory school vaccination (shaded area) 1870–1950, rate per 100,000.

cination. In states enlightened enough to require vaccination for school attendance, no cases of smallpox occur except the few introduced from other states.

Table 17

SMALLPOX RATE IN RELATION TO VACCINATION LAWS: 1938 TO 1941

Legal Status of Vaccination	*Number of States*	*Cases per 100,000*
Vaccination required as a prerequisite for school attendance	13 and District of Columbia	0.8
Vaccination may be required at any time	6	3.0
Vaccination may be required under some circumstances	10	3.6
Unvaccinated persons may be excluded from school when smallpox is present or threatens	12	6.3
No efficient laws or regulations favoring vaccination . .	9	11.1
Laws unfavorable to vaccination	7	13.2

If vaccination is performed by modern methods, and the area is not scratched or rubbed and thereby infected, the scar will be inconspicuous. After vaccination in infancy and at five years of age, further vaccination is likely to give only the slight local reaction that indicates immunity.

Leprosy. This historic disease is very rare in this country. It is not especially communicable; only 5 per cent of consorts of lepers develop

the disease. Its exact cause, course, and method of transmission are not surely known even today, and it is rarely fatal. Yet lepers are isolated much more completely than those with diseases much more communicable. The federal government conducts the National Home for Lepers at Carville, Louisiana, where research regarding treatment is conducted. A few patients have been paroled as cured.

Psittacosis. Man is subject to this pneumonialike disease of birds, especially of the parrot family and fowl. Until recently it has been thought rare. It is being studied at the National Institutes of Health where it has been found to be extremely communicable from birds to man. Few cases are transferred from human to human. Prevention is by avoidance of contact, or even of proximity, to sick birds. Public health measures include restriction of importation of birds, and investigation of cases of sickness in domestic birds.

Anthrax. Anthrax is a disease transmitted chiefly through wool, hides, hair, and bristles of infected animals. Although not common, it might easily become so if regulations regarding the inspection and sterilization of these products were not adequate at their source in other lands or after importation. The disease causes skin, lung, and intestinal symptoms, and is always serious.

Glanders. Glanders is an infectious disease of the horse. One type is known as farcy. Man occasionally acquires it when exposed to contact with sick animals. Some of the acute cases are fatal, but chronic cases occur, with the symptoms of nasal discharge or of swellings and ulcers of the skin.

Rat Bite Fever. Rat bite fever, or sodoku, causes chills and fever at intervals of days or weeks over a long period. Usually it is not fatal. Certain other small animals, notably the weasel and the cat, are subject to the disease, and man may acquire it from them. It is rare in this country, however, and few persons bitten by these animals acquire the disease. Sodoku is one of the infections formerly used to induce therapeutic fever for the treatment of the third stage of syphilis.

Actinomycosis. This chronic disease is acquired from cattle or swine, or, rarely, by contact with straw or hay contaminated by secretions of animals sick with the disease. Its most common symptom is swelling of the jaw. If the digestive tract or the lungs are involved, the condition may be serious. Treatment usually is surgical.

13

Problems of Noncommunicable Diseases

Three points should be noted about noncommunicable diseases. First, infection is a factor in some of them. Some begin as infections; with others, infection continues throughout the illness; and with still others, infection often becomes a complication during the course of the illness and may, indeed, be the reason why the illness terminates fatally.

Second, either physical or chemical agents are at least a part of the cause in many noncommunicable diseases.

Third, no external factor can be definitely incriminated in some of the noncommunicable diseases. In such cases, the cause is largely from within the body itself. Such causes may be a disturbed cellular state or a disturbed physiologic process arising either from peculiarities of individual make-up or from personally inappropriate ways of living. Mental attitudes often contribute directly or indirectly. Inheritance may be a determining or a predisposing factor.

Diseases of the Heart, Blood Vessels, and Kidneys

Diseases of the heart total by far the largest cause of death in the United States. Arterial disease ranks third. Nephritis, kidney disease, ranks fourth. Both arterial disease and nephritis are often associated with heart disease. Death rates from these causes were shown in Table 3 on p. 7, and disability rates on p. 10.

Heart Disease

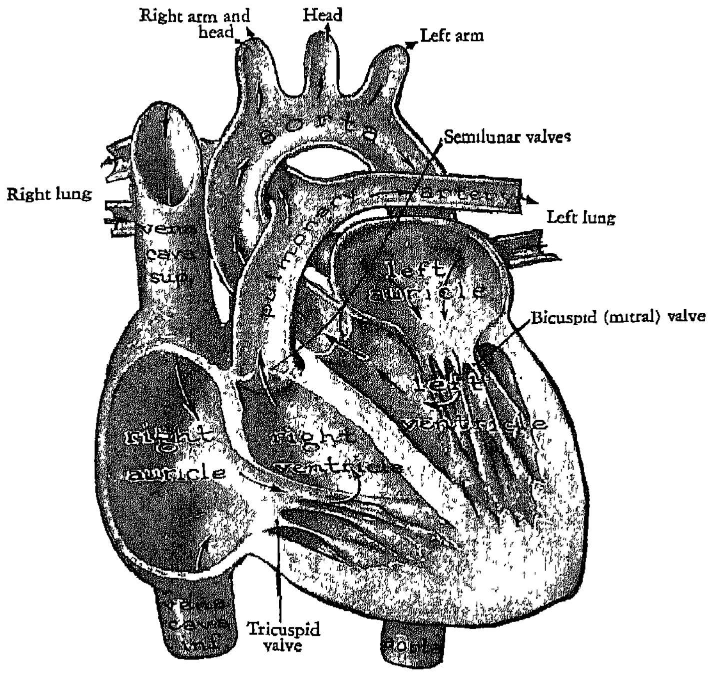
Infectious Causes

When persons under 40 have heart disease it is likely to be due to infection. The two most important infections involving the heart are rheumatic fever and syphilis.

Rheumatic fever usually begins in childhood. It is classed as a febrile

disease which has a high percentage of recurrence and is more common to girls than to boys. Because of its damage to the heart, it is a very serious disease. At or before the onset of the disease there is usually a sore throat, perhaps trifling. Joints are inflamed, although perhaps only slightly. Often a disease of the nerves called chorea (St. Vitus' dance) is present at the same time. Essentially, however, rheumatic fever is a disease of the heart. The infection attacks chiefly the lining membrane of the heart, the endocardium, causing endocarditis. The joints ultimately become normal. The heart may do so also, but often not, especially in those who do not remain under medical care, in bed, until the active infection is entirely cured, often a matter of months.

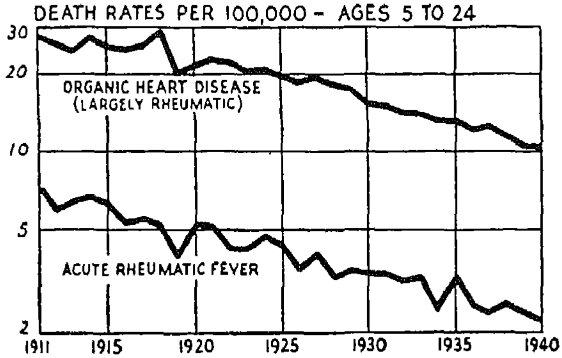
The reason why the heart may be permanently damaged by rheumatic fever is that the germs often localize themselves upon the edges of the valves. Usually the individual recovers from the first attack of heart valve infection, but with the valves deformed. This deformity creates mechanical difficulties in the flow of blood through the heart. The valves may not close completely, and part of the blood that passes through flows back (regurgitation or "leaky valve"); or they may not open completely,



Chambers of the heart, showing valves.

so that the full amount of blood does not flow through at each contraction (stenosis or narrowing).

In the case of valve deformities, the heart must work harder to pump the same amount of blood. If it succeeds in doing so, the defect is said to be compensated. The individual with compensated heart disease is able to live a normal life except that his heart is already working about as hard as it can, and he has little heart reserve for extra exertion. Many persons with compensated valvular disease gradually work up to a high level of activity, but must carefully guard against strain beyond their



Downward trend in mortality rate from rheumatic fever in young people. Marked decreases have occurred in mortality at ages 5 to 24 from both the acute and the chronic phases of rheumatic fever. Since 1911, the death rate from acute rheumatic fever at these ages has declined 69 per cent and from chronic heart disease, 62 per cent.

limit, whatever that may be. They differ in this respect from the thoroughly normal person, in whom it is scarcely possible to strain the heart as long as he remains in normal health.

When valvular disease is present, care must be used to avoid a new rheumatic infection, and indeed any and all infections, for even a trivial infection may further damage an already damaged heart.

In any valvular defect, a murmur may be heard by the physician using a stethoscope over the chest. A murmur does not necessarily mean valvular disease or any other disease. It may be merely a sound created by blood eddies in a normal heart.

Those with valvular disease may live long and well provided they live wisely. They should be under medical supervision, with at least annual examination.

Heart Disease Due to Syphilis. This disease is especially likely to cause damage of the aorta, the large main artery leading out from the heart. Secondarily, the valve between the aorta and the heart may become incompetent. Sometimes the coronary arteries from the aorta to the heart muscle become narrowed. It is thought that each year about 40,000 deaths occur from syphilitic heart disease, nearly all of which could have been prevented by early and adequate treatment.

Myocarditis. Other infections often cause myocarditis—weakening of the heart muscle. This may occur as an acute condition during such diseases as diphtheria, scarlet fever, influenza, erysipelas, and malaria. Treatment of the infection may cure the heart condition. After the heart has been affected thus, long rest in bed may be required to prevent an acute myocarditis from becoming chronic.

Circulatory Causes

When persons over 40 have heart disease, the condition usually is chronic myocarditis or damage of the heart muscle. As a result, the heart eventually loses its contractile power. Most of its muscle cells may indeed die and be replaced by fibrous tissue which is a noncontractile connective tissue.

Chronic myocarditis may follow acute myocarditis, as mentioned above. Or it may begin either suddenly or insidiously as a result of defective blood supply to the heart muscle through its coronary arteries. Many cases of chronic myocarditis are associated with diseases of the arteries, or chronic high blood pressure, or kidney disease, as will be mentioned.

ARTERIAL DISEASE

Arteriosclerosis. Normally, the arteries are elastic tubes which adapt readily to the volume of blood that goes through them. They become stiff and inelastic (sclerotic) as a result of the growth of fibrous tissue replacing muscle and the deposit of calcium in their walls. This often occurs as a part of the aging process, but may occur earlier than old age.

There appears to be no single specific cause of this condition. Apparently heredity is a factor. Infection may cause it to progress rapidly, and possibly may be one of its original causes. Many believe the disease is essentially a metabolic disorder, since it often occurs with diseases of that nature (e.g., diabetes, gout, nephritis, and obesity). Others believe that excesses in work and in emotion hasten the aging of the arteries. Per-

sistent high blood pressure almost invariably leads eventually to arteriosclerosis. One poison, lead, is known to cause the arteries to harden. Certain other poisons—for example, tobacco smoked to excess—are suspected of having the same effect.

Sclerosis of any arteries leads to degeneration of the tissues whose circulation is thereby limited (e.g., kidneys, causing nephritis; brain, causing mental disease; heart, causing arteriosclerotic heart disease).

Special dangers are that a sclerotic artery will rupture or that a clot (thrombus) or embolus will form in it. In either case, the results depend upon the vessel involved. Occurring in the brain, either hemorrhage (from rupture) or thrombosis or embolism (from clotting) produces the condition commonly known as a "stroke" of apoplexy or a "shock." The patient often dies. The paralysis which occurs at the time of these cerebral accidents may remain present. In the heart, when a clot blocks an artery, it is called coronary thrombosis or coronary occlusion.

Coronary Disease. When the coronary arteries are contracted by spasm or occluded by a thrombus, the blood supply to the heart is greatly reduced or shut off entirely. The heart fails suddenly, with intense pain. The outcome depends upon the degree to which the heart muscle is deprived of blood. In many cases, death occurs at once. In other cases, recovery occurs, but with one segment of the heart permanently damaged as a result of its loss of blood supply. Even in severe cases, however, recovery may occur if, during a long period of rest, secondary coronary arteries increase their carrying capacity and become able to supply the heart muscle with due nutriment.

Coronary heart disease may occur in those who have generalized arteriosclerosis, but often the coronary arteries are the only ones seriously involved. Persons most often afflicted are men of middle age who have constantly lived under tension and responsibility, without enough rest and relaxation of mind or body. Any of the causative factors mentioned in reference to arteriosclerosis may be present.

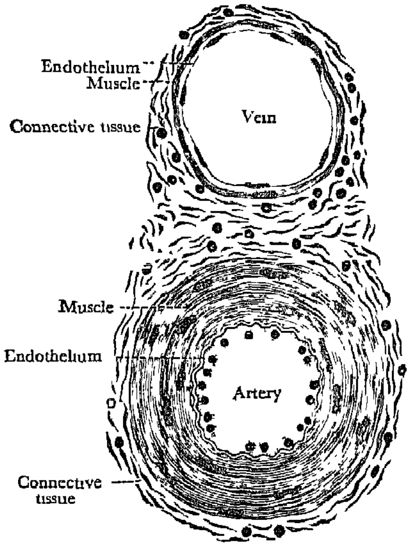
Coronary disease is one of the few from which the death rate is increasing.

High Blood Pressure

In persons having persistently high blood pressure, hypertension, the heart for some years continues to work harder than normal, but this causes it ultimately to weaken and fail, with hypertensive heart disease.

Hypertension may appear early in life, and the cause may be obscure.

Usually, however, it appears at middle age and is often accompanied by arteriosclerosis, the two being due apparently to the same cause. Almost always, nephritis leads in time to hypertension. When present with arteriosclerosis, hypertension increases the hazard of ruptured blood vessels.



Transverse section through a small artery and vein.

All persons with high blood pressure—constantly or even occasionally—should be under medical supervision and have at least an annual examination. Under the guidance of the physician, many persons with hypertension have been able to adjust their habits so as to reach a ripe old age. The habits to be adjusted often include keeping the weight down to normal; avoiding excessive use of tobacco; and striking a wise balance between work and rest, both mental and physical. Many other matters may be of equal importance in a given case.

Kidney Diseases: Nephritis

The term nephritis is applied to several abnormal conditions of the kidney substance, all popularly called Bright's disease.

Acute nephritis may accompany or follow infection anywhere in the body. The kidneys are often involved in scarlet fever, diphtheria, rheumatic fever, septic sore throat, and septicemia, and not uncommonly in severe colds, sinus infection, wound infection and even in the skin

disease, impetigo. Puffiness of the face, especially of the eyelids, is an early symptom, and should be investigated. If detected early in the acute stage, the chances of recovery from nephritis are good; if neglected, chronic nephritis may develop and ultimately be fatal. For this reason, if for no other, one should be under medical observation during all infections.

Chronic nephritis may be the end result of acute nephritis, but in most cases of this disease infection is not a factor. The most common type of nephritis begins at or beyond middle age, and represents degeneration of the active cells of the kidneys due to poor blood supply to them, as when their arteries are narrowed and hardened. The condition is analogous to chronic myocarditis. Although chronic nephritis from any cause is incurable, it may progress slowly and may permit many years of satisfactory living if the patient is under medical supervision and follows advice.

Pyelitis is an infection not of the kidney substance but of the lining membrane of the cavity within it. It may be due to bacteria from anywhere in the body, but often is an infection which has ascended from an infected bladder. Pain in the loins is one of the symptoms of this disease, but not of most kidney diseases. Ordinarily, pyelitis is curable, but it may extend to the kidney substance, causing pyelonephritis, a more serious condition.

Cystitis (inflammation of the bladder) usually is due to bacteria which enter through the blood from remote infection or through the urethra. Symptoms include frequent and somewhat painful urination. It is usually not serious unless it extends to the kidney.

Urinalysis is one of the most important diagnostic tests for kidney and bladder disease. It is recommended that all persons have the urine examined annually. Certainly this should be a routine in all those who have ever had trouble in these organs, and in all those at or beyond middle age, even though they seem to be healthy.

Cardio-vascular-renal Disease

The interrelationship between heart disease, arteriosclerosis, high blood pressure, and nephritis is very close. One may cause all the others, and each may increase the other, in a vicious circle called cardio-vascular-renal disease. Such a condition usually does not appear until middle age. Although incurable, its progress may often be delayed by wise management.

Diseases of Veins

Varicose Veins. Varicose veins, or varix, ranked seventh in the National Health Survey of causes of disability, although it is not often fatal. The condition occurs when veins are persistently overfull; in such circumstances they tend to dilate and lengthen and become tortuous.

It is believed that in some persons the walls of the veins may be hereditarily weak and predisposed to varix. Special precautions are therefore required by those in whose families these disorders are prevalent.

Circulation through leg veins is difficult at best, for it is against gravity. Two factors are likely to cause leg veins to overfill: *first,* pressure upon them, which causes back pressure below that point (as in pregnancy, when the uterus presses upon large intraäbdominal veins; and in those who habitually sit with knees crossed or wear tight garters around the leg); *second,* long periods of standing, during which the large muscles do not contract strongly and therefore do not exert enough pressure upon the veins to help move the blood upward.

The treatment of varicose veins of the leg is either by the use of a chemical to obliterate them, or an operation to remove them. Other veins lying deeper in the tissues usually are normal, and will care for circulation after the superficial ones have been thus treated.

Hemorrhoids are varicose veins of the anus and rectum. They may become dilated as a result of pressure of fecal masses in constipation, or as a result of straining at stool. Sometimes they may feel irritated, but when located internally, a commoner symptom is slight bleeding. Treatment is by correction of constipation, local medication, obliteration by chemicals, or surgical removal. Any soreness or bleeding in this area should be given attention.

Varicocele is varicose veins of the scrotum. If slight in degree, no treatment may be needed. In more marked cases, a well-fitted suspensory bandage may be required, or the veins may be treated by surgery, or other methods.

Phlebitis. Phlebitis means inflammation or infection of veins. It is perhaps more likely to occur in veins that are varicose, but may occur in normal veins. The chief danger is that a clot (thrombus) may form, become detached, and circulate to an important organ, shutting off its blood supply, perhaps with fatal results. Bed rest is always required until this danger is passed. Phlebitis in the leg is not uncommon in women after childbirth, during lactation, for which reason it is called "milk leg," but

it may occur in other circumstances (e.g., after injury or during an infectious disease) in either males or females.

Cancer

The body is characterized by an orderly growth of cells from the moment of conception onward. The rate is very rapid at first, and gradually becomes slower until, in adult life, whatever cell growth takes place in replacement of lost cells is at a very slow rate. Furthermore, normal cell growth is orderly and serves useful purposes.

In contrast to this slow, orderly growth, the cancer is a local center of rapid, disorderly growth—a wild growth serving no useful purpose, but causing destruction instead. The term malignant (acting maliciously) is applied to such growths. They harm the body in several ways: by consuming so much nutriment that the body wastes away; by destroying tissue necessary to health; and finally by poisoning the body with toxins given off from the destroyed area.

The damage is multiplied when a cancer does not remain limited to the small area in which it starts. Cancer may spread by direct extension to nearby parts, or by way of the blood vessels or lymph vessels to remote parts (metastasis).

In spite of much knowledge regarding prevention and treatment of cancer, it has risen in the past 25 years from seventh to second place among the causes of death in this country. Many of the 170,000 cancer deaths each year are entirely unnecessary.

To reduce the death rate from cancer, two things must be done: cancers must be prevented from starting, and cancers must be prevented from progressing to a fatal termination.

1. Prevention of cancer is based upon the fact that cancer often appears in an area that has long been irritated. Any chronic irritation—by mechanical agents (such as friction), or by other physical agents (such as sunlight and other rays), or by chemical agents (many of which produce cancer in laboratory animals)—definitely predisposes to cancer.

The following rules for avoiding irritation such as might lead to cancer were formulated by Dr. Clarence C. Little, one of the foremost authorities on the subject.*

MOUTH, LIP, AND TONGUE. Follow the well-known habits of oral hygiene, keeping teeth, gums, tongue, and mouth clean. Exercise proper dental care, having the

[1] From "The Fight on Cancer" by Clarence C. Little, Sc.D., and Director of the Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Maine, Public Affairs Committee, Inc., 1939.

dentist correct any jagged teeth or ill-fitting plate that might chafe or exert pressure on the tongue, the inside of the mouth, or the gums.

THROAT. Avoid eating too hot food.

STOMACH. Avoid food or drink that causes any digestive distress. The exact procedure to be followed in this case will naturally vary with the individual.

INTESTINE AND RECTUM. Establish habits of bowel regularity. Do not allow hemorrhoids (piles) to continue without being corrected.

BREASTS. Avoid confining, chafing, or irritating clothing, brassieres, or corsets.

UTERUS. See to it that any injuries or tears received during childbirth have prompt and adequate medical or surgical treatment.

SKIN. Keep the skin clean and protected from too much exposure to sun and wind.

2. Prevention of death from cancer is by detecting a beginning cancer while it is still local and can be completely removed. Cancers on or just under the surface of the body can be either seen or felt; those in the interior of the body give symptoms of bodily disorder.

If the following symptoms were always investigated promptly, and were properly treated, many a death from cancer could be prevented (list compiled by Dr. Little).

MOUTH, LIP, AND TONGUE. Any sore that does not heal within ten days to two weeks. Any lump or local thickening. On the tongue persistent white areas, especially in the case of smokers.

THROAT. Difficulty in swallowing, or hoarseness lasting for more than two weeks, which cannot be explained by a cold or other direct cause.

STOMACH AND INTESTINE. Distress following eating, especially in those of middle age or older who have not been previously aware of such a condition. Sudden or marked loss of weight without any recognized cause. Distaste for meat. Alternate periods of constipation and diarrhea with no particular change in diet to account for it. In the case of the lower intestine or rectum, the appearance of blood as a rectal discharge or in the stools.

BREAST. Any lump, lack of symmetry, persistent soreness of the breast, or colored discharge from the nipple.

UTERUS. Any irregular bleeding at any time during life.

SKIN. Any lump or sore that does not heal in ten days to two weeks. Any mole, wart, or wen which develops tenderness, changes its texture, or begins to grow.

Many of these conditions will turn out not to be cancer.

At the start, most cancers do not cause pain, but of course pain is always a symptom to be investigated.

The majority of cancers appear in those over 40, but even in the 15- to 19-year period, cancer is among the 10 leading causes of death in the United States. The type known as sarcoma is especially common in youth. At the age of 35, cancer becomes the leading cause of death in white women.

There are two forms of treatment for cancer—surgery and radiation. Radiation is by x-rays or by gamma rays from radium. The place of

these rays and their wave length was illustrated on p. 172, the electromagnetic spectrum. The atom-splitting cyclotron is being used experimentally as a source of gamma rays in the treatment of cancer. What the new methods of release of atomic energy may accomplish in cancer treatment, is as yet unknown.

Surgery and radiation may be used separately or combined, according to the surgeon's judgment, based upon the location and type of cancer and various other factors.

Fake cancer cures by the hundred are offered to the gullible public and purchased by many who discover their mistake too late to save their lives by scientific methods. Testimonials of those who have been "cured" have no value; if anything was cured, it was not cancer.

Table 18

SURVIVORSHIP OF CANCER PATIENTS* WHO HAVE BEEN TRACED†

Year of Admission	*Per Cent Surviving Specified Number of Years After Treatment*									
	1	2	3	4	5	6	7	8	9	10
1935	42.4	33.7	28.4	24.7	22.1	20.3	18.4	16.7	15.5	15.1
1936	43.5	35.1	30.3	25.8	22.7	20.7	19.3	17.8	16.8	16.0
1937	44.9	34.0	27.9	25.0	22.3	20.7	19.2	17.6	17.0	
1938	44.5	35.3	29.5	26.8	24.6	22.7	21.1	20.0		
1939	46.1	37.2	32.6	29.0	27.0	24.8	23.7			
1940	47.3	40.4	36.7	32.4	29.6	27.7				
1941	52.0	44.2	39.2	35.7	33.5					
1942	54.6	47.5	42.4	39.9						
1943	53.4	45.7	41.8							
1944	54.4	47.6								
1945	58.9									

* Microscopically proved cases.

† Cancer Record Registry, Connecticut State Department of Health, 1935 to 1945.

Accidents

THE ACCIDENT PROBLEM

What Causes Accidents? If accidents were due to pure chance, only the results of them would be of medical interest. But the majority of

accidents do not happen by chance. They are due to physical causes such as muscular weakness, muscular incoördination or awkwardness, poor vision, an attack of some sort (fainting, dizziness, heat stroke, or the like); or they are due to mental causes such as carelessness, heedlessness, stupidity, poor concentration, confusion, exhibitionism (desire to show off), or any of a hundred other attitudes which deprive a person of sober judgment and due caution.

Rate of Accident Occurrence. The total accident death rate in the United States in recent years has been over 90,000 annually. In 1947, the estimated total was 99,579.

In addition, accidents that did not kill but disabled permanently in 1948, amounted to 370,000. Total nonfatal injuries amounted to 10,300,000 in 1948.

In normal years, automobile accidents exceed all others. In 1948, estimated deaths from home accidents totalled 35,000; from automobile accidents of civilians, 32,000; from civilian occupational accidents, 16,500; and from public non-motor vehicle accidents, 17,000.

Table 19

DEATH RATES FROM SPECIFIC CAUSES AMONG SCHOOL CHILDREN 15 TO 19 YEARS OF AGE, UNITED STATES, 1923 AND 1943*

Cause of Death	*Death Rate per 100,000*		*Decrease, Per Cent*
	1923	*1943*	
Tuberculosis	110.7	23.8	78.5
Pneumonia† .	45.4	10.0	78.0
Appendicitis	15.4	4.7	69.48
Rheumatic fever and organic heart disease .	28.9	14.3	50.5
Accidents, total‡ . .	**55.5**	**38.1**	**31.4**
Accidents, automobile‡	**11.1**	**18.1**	**63.1** (*increase*)

* Taken from a table on page 306 of an article by George M. Wheatley, M.D., assistant vice-president, Metropolitan Life Insurance Company, in *The New England Journal of Medicine,* February 17, 1947.

† Comparison of 1922–1923 with 1942–1943.

‡ Comparison of 1923 with 1941.

Major Causes of Fatal Accidents in U.S.A., 1949

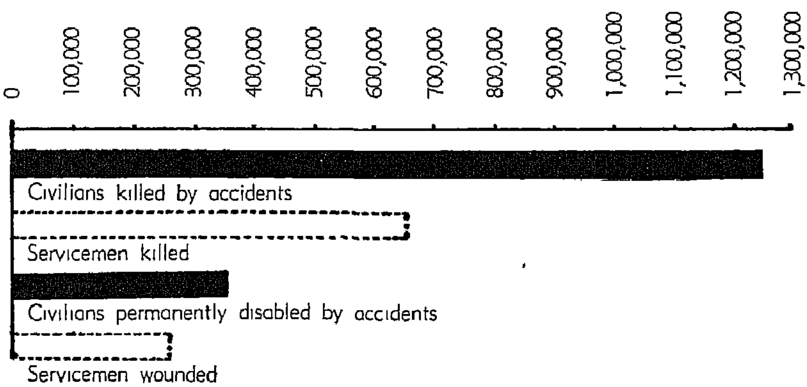
Automobile accidents (except collisions with trains and streetcars)	**30,827**
Injury by fall	**22,581**
Drowning	**5,577**
Conflagration	**3,017**
Railway accidents (except collisions with motor vehicles)	**2,937**
Injury by firearms	**2,816**
Agricultural accidents	**2,047**
Accidental absorption of poisonous gas	1,847
Air transport accidents	1,851
Collisions between automobiles and trains	1,703
Mechanical suffocation	1,605
Acute accidental poisoning by solids or liquids	1,536
Mines and quarries accidents	1,273
Other accidents involving machinery	1,173
Water transport accidents	1,055
Streetcar and other road-transport accidents	734
Accidents due to electric currents (except lightning)	725
Motorcycle accidents (except collision with automobiles)	707
Streetcar accidents (except collisions with trains or motor vehicles)	544
Injury by crushing	447
Forestry accidents	406
Food poisoning	369
Injury by cutting or piercing instruments	317
Lightning	231
Excessive cold	193
Other unspecified road transport accidents	190
Excessive heat	182
Collisions between automobiles and streetcars	174
Cataclysm	148
Injury by animals	142
Sequelae of preventive immunization, etc.	66
Poisoning by venomous animals	62
Hunger or thirst	27
Other unspecified accidents	**6,375**
TOTAL	**98,033**

Accidents in Homes. A large proportion of fatal accidents at home are from falls and burns.

In 1948, there were 18,200 deaths in the United States from falls at home, and 85 per cent of these were in persons 65 years of age or over. Many fatal falls occur on stairs and floors, by tripping over loose objects, such as slippery floors or objects left where they do not belong. Falls also occur among persons under 65, often as a result of climbing around a house inside or outside, while painting, making repairs, and housecleaning, or in play.

In 1948, there were 6000 deaths from burns received at home; 29 per cent were in children under 5, and almost as many in persons 65 or over. In children, fatal burns are often due to scalding by hot fluids, spilled by an adult's carelessness. The combination, "children and matches," still accounts for many fires annually. Other common causes of fires are carelessness in smoking; misuse of electricity or gas, or defective equipment for their use; defective stoves, heaters, furnaces, boilers, chimneys, and flues; collections of inflammable materials such as paper, wood, or rags near heaters or flames; and use of inflammable cleaning fluids. Fires often are more serious than they need be because those at hand do not know how to put them out when they start, and perhaps do not even know how to summon the fire department. Burns are more often fatal than they need be because no one at hand knows what to do, and what not to do, as first aid.

Other common home accidents include: poisoning (1450 deaths from gas poisoning and 1450 deaths from other poisons in 1948); mechanical



Number of military personnel killed and injured from Pearl Harbor to VJ Day, contrasted with the number of civilians in the United States killed and permanently disabled by accidents.

suffocation (1800 in 1948, due chiefly to smothering by bed clothes, and occurring chiefly in children under 1); suffocation by an object in air passages (1206 in 1947, also chiefly in children); and fatal firearm accidents (1150 in 1948, chiefly from carelessness in handling or cleaning a gun, or playing with it as a toy).

Why Are Automobile Accidents So Frequent? In a small number of automobile accidents, the car itself is at fault. In a few, the condition of

Table 20

PERCENTAGE OF DEATHS FROM SPECIFIED CAUSES AT SPECIFIED AGES, WHITE MALES AND FEMALES, UNITED STATES, 1942

Cause	*Ages 15–19*		*Ages 20–24*	
	Males	*Females*	*Males*	*Females*
Accidents	**48.0**	**18.3**	**50.5**	**11.5**
Tuberculosis	6.4	16.0	9.4	22.9
Chronic heart disease*	6.9	9.2	5.7	9.1
Digestive system diseases	6.6	7.1	4.8	6.0
Pneumonia and influenza	4.5	5.1	3.6	4.2
Cancer	3.2	3.6	2.9	3.7
Chronic nephritis	1.9	3.4	2.0	3.1
Puerperal state	...	8.5	...	15.4
All other	22.5	28.8	21.1	24.1

* Includes cerebral hemorrhage, coronary artery disease, and angina pectoris.

the road is responsible for accidents. In the vast proportion of accidents —regardless of car and road—it is the driver who is to blame, and it is believed that the fault with the driver is most often a fault of his state of mind.

Two classes of persons are especially prone to have automobile accidents, as shown by records: (1) young males, and (2) those under the influence of alcohol, of whatever age. Young males have had so many accidents that many insurance companies today refuse to insure men between 18 and 21, or, in some cases, those even older.

The usual explanation for the young male's high rate of accidents is not that he lacks skill, but that he does not properly gauge the mechanical

possibilities of his car and himself and of other cars and drivers. He overestimates what his skill can do in given traffic conditions.

How Alcohol Increases Driving Hazard. A recent report of the National Safety Council stated that half the drivers and one third of the pedestrians killed in automobile accidents had been drinking. From various investigations it appears that the driver with a blood concentration of 0.15 per cent or more of alcohol is 55 times as likely to have an accident causing personal injury or death as the driver without alcohol.

The expression "under the influence" of alcohol has been defined by the supreme court of one state as including "not only the well-known and easily recognized conditions and degrees of intoxication, but any abnormal mental or physical condition which is the result of indulging, in any degree, in intoxicating liquors, and which tends to deprive him (the imbiber) of that clearness of intellect and control of himself which he would otherwise possess. . . ."

An authoritative British committee summarizes the situation as follows: "Alcohol impairs skilled movements, and this fact is most important in the driving of automobiles. Vernon made an experimental study, by means of an artificial motor-driving apparatus, on the effects of small quantities of alcohol (from 20 to 45 cc., as in the form of ½ to 1½ ounces of whiskey) taken on a practically empty stomach, on the driving capacity of various persons. He found that by far the majority drove more quickly and more erratically than in normal circumstances. For the most part they did not realize that they were driving faster, but one deliberately drove more slowly because he realized his reduced control and several drove for short distances with a rush and then slowed down before again driving faster. There was far greater variability not only in speed but also in accuracy and carefulness after alcohol had been taken. This was noticeable even after the amount of alcohol was reduced to that contained in half a tumbler of mild beer (5 cc.). Some persons were certain that they were driving better although they were driving worse. Other experiments revealed not only an impairment of attention to signals and environment but also slower responses of the eyes, hands and feet."

Poor Vision and Driving Accidents. Accidents often occur in those whose dark adaptation is poor; they do not see well in dim light and suffer from glare blindness. This is often due to lack of sufficient vitamin A in the rod cells of the retina, and is preventable and curable by due absorption of vitamin A from the diet, or as medication.

The nearsighted are handicapped by not seeing distant objects well. The one-eyed are handicapped in two ways. First, since they do not see objects from two slightly different angles as do the two-eyed, they lack the sense of perspective, which is necessary for forming estimates of size and distance. Second, the "blind spot" normally present in the eye is, for them, actually a blind spot, not counteracted as in the two-eyed by the fact that the two blind spots are not directed toward an object at the same time.

The Rate of Other Vehicular Accidents. The rate of fatal accidents from land vehicles other than automobiles (railroad trains, trolley cars) not in collision with automobiles, has steadily decreased since 1923. Railroad trains caused only 52 deaths of passengers in 1948. A total of 4060 persons were killed in 1948 in connection with railroad operations, but a large proportion of these are classed with motor vehicle accidents because they were due to collision of a train and an automobile carelessly crossing railroad tracks at grade crossings.

The rate of airplane accidents per occupant mile has also decreased, especially in scheduled commercial transport flying. In 1948, the latter caused the deaths of only 83 passengers and 15 crew members. Amateur fliers are said to be 20 times as likely to have a fatal accident as professionals.

Deaths from bicycle accidents result chiefly from collision between motor vehicles and bicycles. The total in 1948 was about 500 deaths.

Industrial Accidents. In view of the hazardous nature of many occupations, the accident rates in industry are remarkably low. This is due to intensive work for safety on the part of employers, and intelligent coöperation on the part of employees. Many large industrial concerns have records of millions of consecutive man-hours free from disabling injury.

Are Sports Safe? Comparatively few serious accidents occur from organized athletics, and the number has steadily decreased, chiefly because of better coaching and equipment, and more frequent use of physicians in examining candidates for organized sports, and in giving immediate treatment of injuries.

Two sports, however, are the cause of many fatalities—water sports and hunting. Drowning killed 6800 persons in 1948, and most of the victims were young persons, chiefly males, in the water for pleasure. The annual rate for drowning has, however, steadily decreased since 1913, undoubtedly because the public has become increasingly familiar with

the art of swimming and the technics of water safety, rescue, and resuscitation.

Hunting is the other sport which causes many fatalities. In 1948, there were 1150 deaths from accidental shooting, of which nearly a third occurred while hunting. They often involved mistaking another individual for the game, or carelessness in handling the gun, as while climbing over a fence, or falling down while carrying the loaded gun. The number of deaths from accidental shooting has decreased in spite of the increase in the number of hunters and is due in part to highly colored (red) caps and clothing.

How May Personal Safety Be Increased? Many of the personal measures for keeping free from accident have been suggested in stating their common causes under the two headings, bodily defect, and faulty judgment.

In the population some individuals are known as accident-prone because they repeatedly have accidents. These persons usually make up about 10 per cent of any group, but they have about 75 per cent of the group's accidents. It has been estimated that if all persons had as many accidents as the accident-prone, our national annual accident rate would increase 750 per cent; but that if the accident-prone had as few accidents as the others, our rates would be reduced to 25 per cent of the present average.

No single defect prevails among the accident-prone, and the remedy for such a proclivity in a given individual is not always easily to be found. With them, as with all persons, the aim is to correct any of the physical or mental defects such as might lead to accidents. The help of others should be obtained in analyzing the circumstances in which the individual has an accident, in the attempt to determine his own causal relationship to it. Not even a trivial accident should be disregarded as mere chance; finding the reason for it, and correcting it, may prevent more serious accidents in the future.

How May Public Safety Be Increased? As a public health problem, safety requires engineering to make all our mechanical devices, including roads, as safe as possible; education to show ways in which accidents occur and the means of avoiding them, and enforcement of regulations, in public places and wherever officials have jurisdiction, regarding safe equipment and safe practices.

Many industries, schools, and communities have established safety programs which have already been effective in reducing accidents. All

work for safety has been greatly aided by the National Safety Council and the data it gathers, analyzes, and furnishes to the businesses which support it and to other officials and individuals interested in promoting safety.

Alcoholism

Alcohol is a narcotic drug, classed by itself rather than with those listed on p. 227, because of special problems involved in its sale and use. When present in medicines, the amount of alcohol must be stated on the label; but when sold as alcoholic beverages, it does not come under the Federal Food, Drug and Cosmetic Act.

It was suggested at the 1941 meeting of the American Medical Association, that if this Act "is designed to prevent and to protect the American public from the menace of drug intoxication and addiction, then it should apply to alcohol as its first drug." The speakers, eminent neuropsychiatrists having special experience with drug addiction, proposed that every bottle of liquor bear the following label:

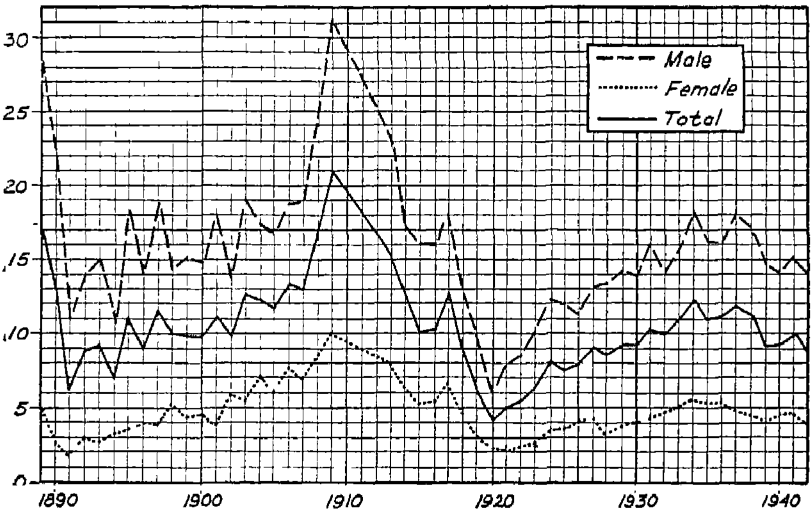
"DIRECTIONS FOR USE: Use moderately and not on successive days. Eat well while drinking and, if necessary, supplement food by vitamin tablets while drinking. *WARNING: May be habit-forming; not for use by children. If this beverage is indulged in immoderately it may cause intoxication (drunkenness), later neuralgia and paralysis (neuritis) and serious mental derangement, such as delirium tremens and other curable and incurable mental diseases, as well as kidney and liver damage."*

The Action of Alcohol. Alcohol is absorbed rapidly by the stomach and the intestines and distributed throughout the body, especially to the brain and other nerve tissue. It exerts a depressant rather than a stimulating effect upon various functions.

Its effects are chiefly (1) disturbed brain function and (2) incoordination of muscle-nerve action.

How Alcohol Affects the Brain. The first effect of alcohol upon the brain is dulling of the higher cerebral faculties—attention, judgment, and discrimination. These faculties represent the climax of human attainment. They normally guide behavior by checking impulsive responses at the more primitive levels, and by promoting responses at the higher levels acceptable to civilized man and society.

When normal checks are removed, personality and behavior change in various ways. For example, the tongue-tied may become loquacious;



Percentage of cases admitted to mental hospitals in New York State, 1889 to 1942, in which alcohol was said to be primarily responsible for hospitalization.

the reserved, sociable. How far a person may go when his inhibitions are released depends upon the person. In some, even the least lack of restraint may bring out a natural crudeness hidden until alcohol reveals it. Primitive man may appear with all his native impulses unleashed. Conduct an individual ordinarily would consider reprehensible may seem attractive, even praiseworthy. Risks that normally would be shunned may seem perfectly safe. For example, the sort of recklessness that leads to exposure to venereal disease has long been known to be a common effect of alcohol.

The amount of alcohol that affects the brain in these ways varies with different individuals. With many, these effects appear, in some degree, before blood concentration has reached 0.1 per cent.

As for intellectual work involving speed, accuracy and discrimination, tests show that these powers, too, are impaired, although work requiring release of imagination may be improved in range if not in quality.

Alcohol and Neuromuscular Coördination. The familiar reeling gait is not the first evidence of incoördination. Long before the skeletal muscles of the legs are affected, incoördination appears in the smaller muscles, and gives varying degrees of inaccuracy in manual and visual work.

Dr. Walter R. Miles of Stanford University experimented with rats

trained to run through a maze to reach their food, to determine the effect of different drugs. After alcohol, they apparently knew how to find the way out, but were not able to walk straight. After some other drugs, they could walk, but did not know where to go. One commentator on these findings remarked that no drug yet tried will produce a performance that is an improvement on the normal.

Any degree of incoördination is likely to lead to poor work, which is one of the reasons why manufacturers do not approve of having workers take alcohol. Also, incoördination is likely to lead to personal injury. In a 15-year report of a large hospital in Boston, 16,054 alcoholic patients were received, and of these, 14,668 had received injuries as a result of accidents. Nearly 11,000 of these were head injuries, ranging from contusions and abrasions to fractured skulls.

Alcohol unfits a person for driving by reducing both judgment and muscular coordination. This important subject was discussed on p. 290.

Is Alcohol a Food? Alcohol is a combustible substance yielding approximately 7 calories per gram. Its food value is exclusively that of a fuel, to be burned with the release of energy. It has no food value for the upbuilding or repair of tissues. When it causes an increase of weight, it is because of sparing fat food to some extent and permitting fat to be deposited in adipose tissues. Actually, it sometimes leads to excess weight, as in those who drink much beer. As a food, it has no advantage over sugar.

Alcohol as a Medicine. Concerning alcohol as a medicine, the American Medical Association in 1917 passed the following resolution:

"Whereas we believe that the use of alcohol is detrimental to the human economy, and its use in therapeutics as a tonic or a stimulant has no scientific value; therefore, Be it resolved that the American Medical Association is opposed to the use of alcohol as a beverage; and

"Be it further resolved that the use of alcohol as a therapeutic agent should be further discouraged."

The opinion of an authoritative British committee was recently summed up as follows: "Alcohol has no practical value as a direct stimulant of the heart in cases of threatened failure. When it appears to promote recovery from fainting, this is due to its irritant action on the mucous membrane of the mouth and is comparable to the action of smelling salts. When, in conditions of more protracted cardiac weakness, alcohol has a beneficial effect, this is due mainly to its mildly sedative action, relieving the centers which modify the action of the heart from

the disturbing influence of pain and anxiety. The mildly narcotic action of alcohol is the most important effect from the therapeutic point of view. It may relieve distress and promote sleep; but it must be prescribed with care and judgment. During convalescence or in a chronic illness it may improve the appetite."

Is Acute Alcohol Poisoning Ever Fatal? The lethal point in alcohol concentration in the blood is considered to be 5 mg. per cc. But an individual may be seriously poisoned and unconscious, in a state of coma, before that level is reached. Death has been reported from 5 ounces of straight alcohol.

The person who is unconscious from alcohol poisoning needs medical treatment at once. If he recovers he will probably not have any lasting effects from a single attack. If death occurs, it will be from depression of the vital centers in the medulla.

Occasionally death occurs because of the simultaneous use of alcohol and medicine containing strychnine. These two drugs form a fatal combination. Some cathartics and tonics contain strychnine.

Chronic Alcoholism. After often repeated doses over a considerable period of time, chronic alcohol poisoning is likely to occur. One may become chronically poisoned without ever having been acutely intoxicated.

A person is either already, or is likely to be, an alcoholic if he drinks every day, or if he has occasional bouts of drinking for days at a time.

Chronic alcoholism is a progressive disease as long as drinking continues. Its major manifestations at first are nervous irritability, mental instability, insomnia, headache, tremor of the hands, tongue and lips, and a change of personality. It precedes or complicates many other diseases.

Some of the symptoms found in the alcoholic appear not to be due to alcohol itself, but to habits common in the alcoholic. For example, the diet may be so restricted as to give too little nourishment. Lack of vitamin B has been found often to be the cause of the motor nerve paralyses such as occur in alcoholism.

The most serious effect of chronic alcoholism is upon the mind. An alcoholic is subject at any time to acute mental symptoms, of which delirium tremens is the most familiar, or to a progressive deterioration of the mind, resulting in chronic mental disease. It has been reported that alcoholism is the cause of 10 per cent of first admissions to mental hospitals in the United States. The graph on p. 291 shows the percentage in one of the states.

Chronic alcoholism frequently causes death. For obvious reasons, the precise cause of death in such cases is not always stated. According to the United States Census Bureau, only three out of 1000 deaths are ascribed to this cause. But alcoholism is mentioned as a secondary cause in three times as many cases, or in one death in every 100. It is believed that it plays an important role in many cases when it is not mentioned in any way on the death certificate. For example, 14,940 deaths in 1947 were ascribed to cirrhosis of the liver, but alcoholism was mentioned as a cause in only 2228 of these. Undoubtedly, alcohol played a part in causing many of the other 12,712 deaths from cirrhosis of the liver. The same may be true of many of the deaths ascribed to accident, heart disease, kidney disease, psychosis, and the like. In fact, it seems probable that if death certificates always told the whole story, alcoholism would rank among the first 10 causes of death. Its importance as a cause of physical, social, and economic disability is generally recognized as greater than any statistics indicate.

Can Chronic Alcoholism Be Cured? Sir William Osler, one of the greatest medical authorities, said, "Once fully established, the habit is rarely abandoned." Nevertheless, in some cases, if the habit can be abandoned, physical and mental rehabilitation is possible. It has been stated that if the individual is no more that 35 years old, in good physical health, and has been drinking for no more than seven years, the outlook is good. Since the alcoholic usually cannot give up alcohol if it is at hand, institutional treatment often is necessary.

There are various forms of treatment for alcoholism. One of these is the conditioned reflex treatment. The patient is given a nauseating medicine at the same time that alcohol is given. He develops an aversion to the combination, and often thereafter cannot tolerate the sight, odor, or even the idea, of alcohol itself. This method is not successful, however, if the individual has been using alcohol for mental reasons, to "forget" or "escape" from situations he cannot face.

When the state of mind is at the root of alcoholism, the treatment is primarily by psychotherapy. The effort is to help the patient find out why he drinks—what problems or situations are unfaced and unsolved—and then to reach a constructive solution so that he will no longer feel the need of alcohol. As an aid to psychotherapy, hypnosis is sometimes used. If an individual really wishes to be helped, not otherwise, psychotherapy often is successful.

Social and religious therapy have a definite part in the cure of

alcoholism. Both methods have produced cures in persons who received wise guidance from their religious advisors or from social workers, and who never consulted their physicians regarding their addiction. An organization called Alcoholics Anonymous, composed of persons who themselves have been, or are, addicted to alcohol, and are trying to help each other by social and religious means, has had much success in recent years.

Prevention of Alcoholism. Hereditary weakness of the nervous system seems to play some part in causing alcoholism. Such weakness may lead the members of a given family both to indulge freely in alcohol, and to be more injured by it. Environment also plays a part, in that it may supply the influence of suggestion and opportunity. Physical conditions in the body seem to have little effect (so far as is known at present) in predisposing to alcoholism; but states of mind are of great importance.

Most people first begin to drink because alcoholic beverages are at hand and others are drinking them. Thereafter, they continue because they like the taste or like the effect or, again, simply because drinking is a routine in their social group. The habit becomes fixed, and in many cases, the amount taken gradually increases.

One of the leading authorities believes that chronic alcoholism develops only in those of weak or unstable nervous systems. It is this type of person who is least likely to be able to stand on his own feet and establish a genuine foundation for a sense of euphoria, and most likely to resort to alcohol for his mental support and satisfaction in life.

Often alcohol does not meet the need of the present situation, and yet gives a feeling that it has, thus preventing the use of constructive measures.

For example, the shy person, so inhibited that he cannot associate with others easily and naturally, may value alcohol highly as a means of making himself socially acceptable. Yet it may not have made him so; the release of his inhibitions may have gone just too far, and instead of being as brilliant and witty as he feels, he may appear to others merely excited or "silly." Second, if he is pleased with himself after drinking, he is less likely to take any constructive steps to develop a normal degree of social ease.

Since the euphoria created by alcohol is a false one, and at best transitory, it would seem sounder to establish genuine sources of euphoria. This, unfortunately, is beyond many people. But the person who can

create a personality and a life situation that give satisfaction, who does not have to flee into a fairyland to make his dreams come true, is scarcely likely to fall a victim to alcoholism.

Alcoholism as a Major Public Health Problem. An editorial in the New England Journal of Medicine, July 13, 1939, states, "Tuberculosis, syphilis and alcohol are three of the major problems in public health. . . . The world is waking up to the fact that it is possible to do away with both tuberculosis and syphilis. The treatment of alcoholism as a public health problem has fallen far behind the other two."

In 1940, the Research Council on Problems of Alcohol, a group composed of eminent scientists, physicians, business men, educators, and public health officials, began work with the announced objective, "the cure and prevention of alcoholism and the alcoholic psychoses." It, too, has stressed the great need for additional facilities for treatment.

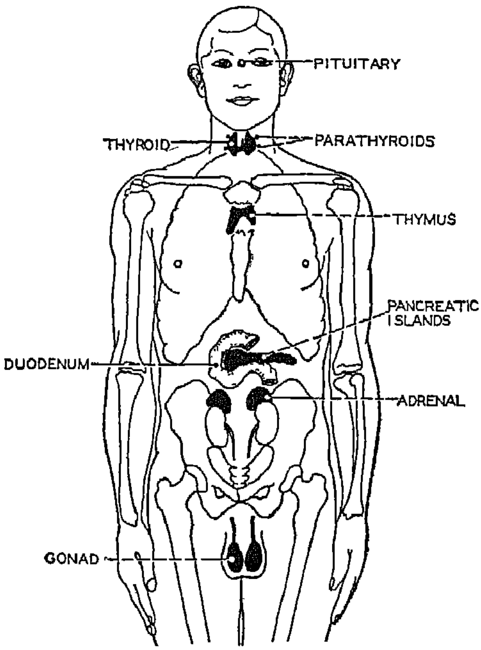
Diabetes and Other Endocrine Disorders

Much is known about 15 endocrine hormones, and something about many others. As mentioned in Chapter 2, these hormones form an intricate system for chemical regulation of body growth and function. Each acts as a check or a stimulant upon others. Harmonious interaction is essential; no gland can produce too much or too little of its hormone without affecting the whole system. As Stockard has said, "Pronounced disagreements and violent disruptions among the members of the glandular oligarchy produce serious and weird diseases of growth, metabolism, and nervous and mental functions."

The balance among the hormones normally differs at different periods of life. For example, the growth-promoting hormones are naturally most active during youth, and the sex-stimulating ones during the reproductive period. Also, the balance of hormones differs within normal limits among different types of persons. It is thought that many racial characteristics are due to slight predominance of one hormone over another. A slight excess of one of the pituitary hormones, for example, may account for the greater height of the European as contrasted with the African and Asiatic. The thyroid may account for the European's longer legs. Similarly, the pituitary and thyroid may influence the characteristics of hair and skin and facial conformation that differentiate these races. The lighter color of the European also may be due to a relatively greater activity of the adrenal glands. Possibly a relative predominance of the thyroid may account for the Caucasian's normally energetic tempera-

ment. All these endocrine factors, it is supposed, are secondary to certain fundamental inherited traits. They cause individuals within races to differ almost as markedly as those of different races.

Prevention of disorders of any of the endocrine glands may well be founded upon the protection of the health in all possible ways. A second important method is that of regular medical supervision from infancy onward, in order that slight departures from normal may be noted and



The endocrinal glands in man.

corrected, if possible. A slight imbalance among the endocrines often lends itself to treatment by a change in hygiene, or by other medical treatment.

For undersecretion of an endocrine gland, treatment often consists of administration of a hormone from an outside source to substitute for one that is deficient. For oversecretion of a gland or for disease of a gland, removal of the whole or a part of the gland by surgery may be required. If a shortage of its hormone is thereby created, the lack may be met by other glands or by administration of an extract of the gland.

The most important endocrine gland disorder is diabetes. Some of the others are as frequent, but less serious, or as serious, but less frequent.

Diabetes

The disease diabetes is due to disorder of certain cells in the pancreas. These cells manufacture a hormone, insulin, which is necessary for the storage and combustion of carbohydrates. If too little insulin is produced, blood sugar increases and some of the excess sugar is discharged through the kidneys. Early symptoms are excessive thirst, hunger, and copious urination.

A predisposition to the disease is hereditary, as a simple recessive trait. Not all of those predisposed to it, however, need have it. Regardless of heredity, the disease may appear in those who are persistently overweight. Those 26 per cent overweight are 10 times as likely to die of diabetes as those of normal weight. It is common especially in the well-to-do, the well-fed, and the little exercised.

Before 1922, diabetes meant invalidism and death. Since that time, laboratory-made insulin has been available for injection into those who lack it. By the use of insulin, plus a suitable diet and enough exercise, diabetics may now live a practically normal life of nearly average length.

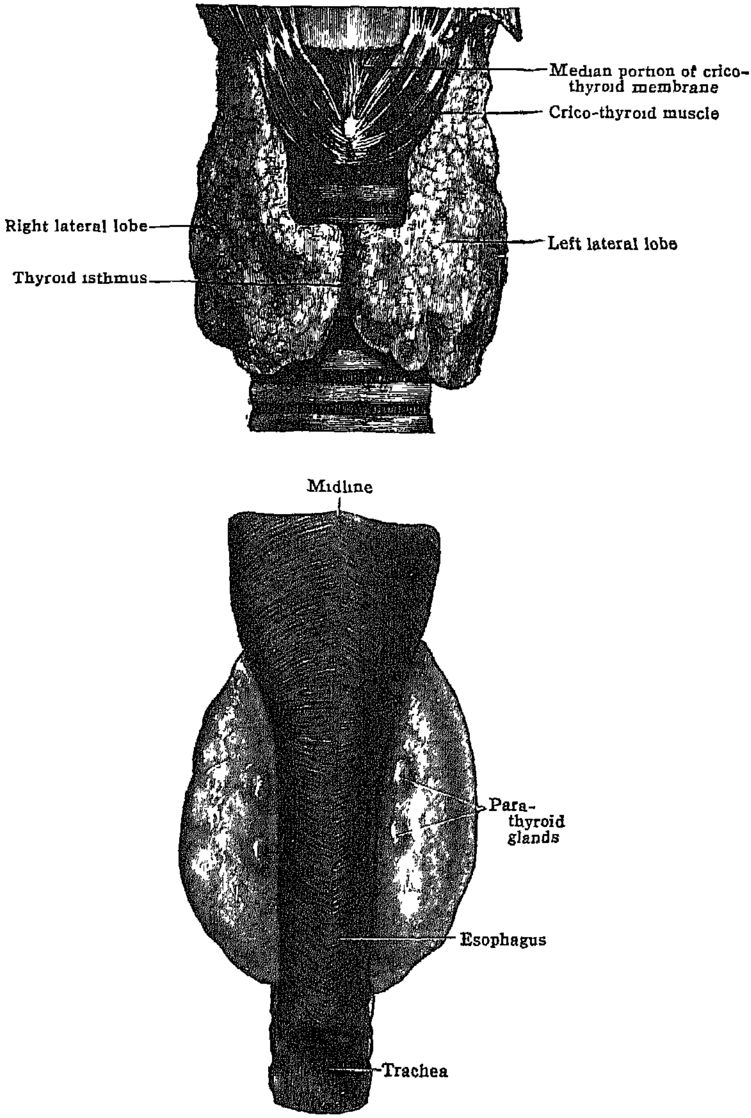
Thyroid Gland Malfunction

Goiter is an enlargement of the thyroid gland. Most commonly it is simple goiter, due to deficient iodine in food and water, in which case it may be accompanied by deficient thyroid secretion (hypothyroidism). Extreme hypothyroidism from birth causes the condition cretinism, characterized by stunted stature and mentality. When acquired after growth is complete, and when moderate in degree, hypothyroidism causes slight lowering of the rate of metabolism, with a tendency to be overweight on a low calorie diet, to "feel the cold," and to have low blood pressure, dry skin, and general sluggishness. In more marked degrees of hypothyroidism these symptoms are more pronounced and the condition is called myxedema.

Hyperthyroidism gives the opposite symptoms—a general speeding up of physical and mental functions. This may be present without goiter. In some cases, the individual is virtually poisoned by his own changed thyroid secretion (toxic goiter). In one type, the eyes become prominent and staring (exophthalmic goiter).

Basal metabolism tests and certain chemical tests of the blood are of use in diagnosing disorders of the thyroid gland.

Many people, without being abnormal, are classifiable as either the



(*Top*) Thyroid body. (*Bottom*) To show the relation of the parathyroids to the thyroid gland.

hypothyroid or the hyperthyroid type, and their hygiene must vary according as they need more "drive" or less.

Treatment of hyposecretion is usually by administration of thyroid extract, and of hypersecretion, by removal of part of the gland.

Adrenal Glands

Disorders of the adrenal glands, although not so often listed as causing specific diseases, are probably responsible for as much poor health as those of any endocrine gland.

The adrenal glands produce one secretion (cortin) in their outer portion, the cortex; and another (adrenin, adrenalin or epinephrine) in their central portion, the medulla.

Lack of sufficient cortin is the cause of Addison's disease which is marked by great weakness and by pigmentation of the skin. It was invariably fatal until a method of preparing the hormone as a medicine was recently discovered. Now cortin keeps this disease under control, and is useful in lesser cortin-deficiency states. Cortin is administered by injection or by planting crystals under the skin (the so-called "hormone agriculture").

Certain tumors of the cortex increase its secretion, which has a tendency to change sex characteristics. The female takes on male appearance and voice; the male may become feminine or more masculine. By surgical removal of the tumor, the individual may, in some cases, be restored to normal.

The medulla performs its functions continuously, in association with the autonomic nervous system, but it has in particular an emergency function. Conditions that produce anger and the need for fighting, or fear and the need for flight, are met by an increase of adrenin, which aids in mobilizing the body's forces for immediate and vigorous response. The following changes result in making energy quickly available. The blood pressure increases, the rate of pulse and respiration increases, the blood vessels of the lungs and of the heart walls dilate; and the bronchioles in the lungs dilate—with the result that more oxygen can be carried more rapidly to the muscles. Simultaneously, the blood vessels in the muscles dilate so that they can receive more blood, and those in the digestive tract contract so as not to retain much blood. Also, a large supply of glycogen is given off from the liver storehouse into the circulation for the muscles to use in contraction. To complete the preparations for a fray, the clotting power of the blood is increased, in order to minimize the harm from possible bloodshed.

Any necessity for increased energy production brings out similar responses, as was mentioned in the discussion of muscle work. They occur, also, in connection with the intense emotions that arise in emergencies

even when no violence is contemplated. For example, a spell of "cramming" is made possible by the easy flow of energy and greater resistance to fatigue brought about by the emergency action of the adrenal medulla.

It is worth-while realizing how the adrenal glands will help out when needed, but there is some danger in thus allowing one's self to be perpetually challenged and stimulated. For example, the organs cannot be too frequently deprived of their usual blood supply without interfering with digestion and nutrition; one who is constantly "strung up" is likely to have indigestion and to become malnourished. Similarly, it is not desirable to cause the blood pressure to rise too frequently as a result of repeated violent activity or emotion. It is thought that some types of chronic high blood pressure may be produced through chronic overaction of the adrenal gland.

Because of the marked emergency effect of adrenin, it is indispensable as a medicine in emergencies when the body's responses must be aided (e.g., for dilatation of the bronchi in asthmatic attacks).

The Pituitary Gland

The pituitary gland has been called the leader of the endocrine orchestra, for it produces many of its effects by causing other glands either to increase or decrease their activity, and thereby promotes harmonious united action. In this way it regulates the three major functions of life—growth, nutrition, and reproduction.

Among the most spectacular results of pituitary disorder are giantism or acromegaly, due to excessive secretion; and dwarfing, with obesity, due to pituitary deficiency in early life. At any time in life, obesity may be a manifestation of pituitary deficiency. Usually, disorders of the pituitary gland are made evident in disorder of other glands.

There are three parts of the pituitary gland. An extract of the posterior part, called pituitrin, has long been in use as a medicine to cause contraction of smooth muscle (as of the uterus during childbirth). Extracts of some of the secretions of the anterior part are beginning to be well understood, and are used to substitute for known deficiencies.

Gonads

The gonads (ovaries in the female and testes in the male) produce sex cells for reproduction, and at least two secretions which influence the distinguishing characteristics of the two sexes and the various sex functions.

Removal of the gonads (castration) before maturity prevents typical sex development. In the male (eunuch) height is increased, fat is deposited in feminine fashion, the voice remains high-pitched, body hair is sparse, the sex organs remain immature and sex feeling does not develop. In the female, the appearance fails to become feminine, indeed, may be somewhat masculine, and menstruation does not occur.

After maturity, castration gives only minor changes in appearance, but causes partial or complete loss of sex functions and feeling. The same is true of gonad deficiency owing to disease or age. A relative deficiency begins in all persons at middle life. It may become pronounced in the female after the menopause (cessation of menstruation and the reproductive life), but in males there may be no marked gonad deficiency until old age.

Several laboratory produced hormones of the gonads are used in the treatment of various disorders due to deficiency (e.g., for menstrual pain, and for certain symptoms that sometimes occur at the menopause).

Parathyroid Glands

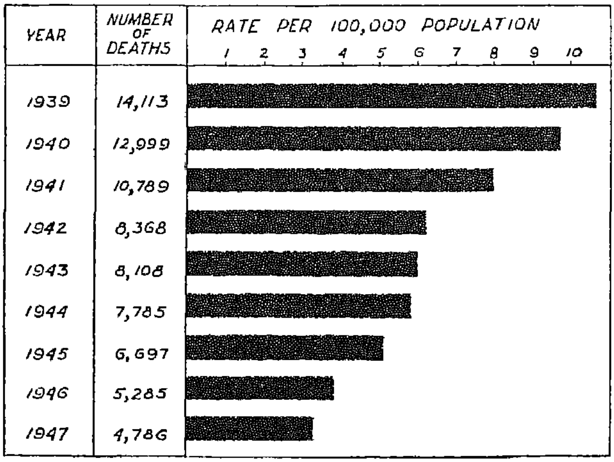
The parathyroid glands are small bodies located behind the thyroid gland. Their importance was discovered when they were removed while removing the thyroid gland. A disease called tetany appeared, with disturbance of muscle action. It was then discovered that these small glands are necessary to the proper use of calcium in the body. Lack of the hormone may be overcome by administration of an extract of the glands.

An excess of parathyroid hormone gives rise to an increased amount of calcium in the blood, at the expense of the bones, which weaken as a result.

Appendicitis and Other Disorders of the Digestive Tract

Appendicitis

Three fourths of the cases of appendicitis occur under the age of 30, and 40 per cent between the ages of 10 and 20. It has been estimated that in this country every year 300,000 persons are operated upon for appendicitis; in 1937–38 there were 11.1 deaths per 100,000 population between the ages of 1 and 74 as compared with 2.7 deaths per 100,000 population in the same age group for 1947–48. The greatest improvement is in the age range of 5 to 45, where the drop amounted to more than 80 per cent. The decrease in the death rate is due to the widespread use of sulfa drugs and penicillin in cases complicated by peritonitis.



Appendicitis decline, 1939–47.

As shown on p. 23, the vermiform (wormlike) appendix is a narrow blind tube attached to the intestine. Its shape and location make it easy for intestinal bacteria to enter it and multiply there, causing a pus infection. When this occurs, the peritoneum (membrane lining the abdominal cavity and covering all organs) in the vicinity also is likely to become infected (peritonitis). When death occurs from appendicitis it is usually because an abscess forms in the appendix, ruptures, and causes a spreading peritonitis.

To avoid fatal consequences from appendicitis, three measures are necessary. First, one who has abdominal pain lasting more than 4 hours should have a medical examination. Pain from appendicitis is not necessarily on the right side at first. In fact, it is likely to be general, or centered around the navel. It is usually, but not always, attended by cramps, and often is accompanied by nausea and vomiting. Sooner or later the temperature rises. (In some circumstances it would, of course, not be advisable to wait as long as 4 hours before securing medical advice.)

Second, while having abdominal pain suggestive of appendicitis, no food or water should be taken, as this tends to stir up peristaltic motion, which is likely to cause an appendical abscess to rupture and peritonitis to spread.

Third, no cathartic should be taken—also because of the likelihood that increased peristalsis would cause rupture of an infected appendix and spread of peritonitis.

If an operation is done promptly (i.e., within a day or two of the first

symptoms) the chances of recovery are excellent (99,991 in 100,000 in one large series). In adults, there is seldom any excuse for delay, for the disease does not usually reach the climax of abscess without warning.

The term chronic appendicitis is often used to describe the condition of an appendix that has been infected and is still mildly so. Usually, when such a condition is diagnosed, it is desirable that the appendix be removed lest the chronic inflammation become acute.

Although it is clear how a fatal outcome of appendicitis may be prevented by surgery, it is not so clear how appendicitis may be prevented from starting. Without demonstrable cause, some appendices become infected and others do not. Good habits of eating and good bowel habits (without the use of cathartics) apparently are of some assistance in keeping the appendix healthy.

Ulcer of Stomach and Duodenum

Ulcers in the stomach and duodenum are called peptic ulcers because their immediate cause is erosion of the mucous membrane by the digestive enzyme pepsin, and the hydrochloric acid of the gastric juice. Such erosion does not occur unless the membranes are abnormal, either inherently so or as the result of irritation or altered nerve impulses to the area.

Peptic ulcer occurs most often in those of high-strung, intense nature. Such persons often work hard, using every ounce of their energy, sleep too little, smoke too much, eat lightly and often fantastically, and are constantly overwrought in mind.

Malnutrition may be a factor in causing peptic ulcer, even in those not "nervous." Animals not susceptible to ulcer may develop it when undernourished. Also, too much smoking may be a cause in itself, acting as an irritant to a hitherto normal stomach. In any persons, infection from other parts of the body may start infection in this region and pave the way for ulcer.

Ulcers usually do not begin suddenly, but rather after a long period of indigestion. If this symptom were always taken seriously and corrected, it would undoubtedly greatly decrease the rate of ulcer. Often a person who actually has an ulcer believes it to be simple indigestion, and doses himself with alkali (sodium bicarbonate and the like). The symptoms are thereby relieved, for the alkali combines with the hydrochloric acid to neutralize it. But the underlying condition is not improved; the ulcer may continue to grow, and ultimately cause trouble.

The danger of ulcer is that it will grow deeper until it perforates through the walls of the stomach or duodenum, discharging the contents into the peritoneum, causing peritonitis; or that serious hemorrhage may occur from it; or that it may obstruct the pylorus.

The treatment of ulcer by medical means (correct diet and correct hygiene in general, plus medication) is successful in about 90 per cent of cases; the other 10 per cent require operation.

Ulcers of the stomach and duodenum were the twentieth cause of disability according to the findings of the National Health Survey, but it is believed that they have become more frequent since then. They caused 8611 deaths in 1947.

Gallbladder Disease

The gallbladder is a small sac lying underneath the liver (see page 23). It is the storage place for bile formed in the liver and given off into the duodenum during digestion. Bile starts the action of one of the digestive juices of the pancreas which is chiefly responsible for digesting fat. When the gallbladder is diseased it may not furnish enough bile to perform this "ignition" action, and fats may fail to digest properly. The commonest disorders of the gallbladder are infection, or gallstones, or both. These diseases occur with about the same frequency as gastric and duodenal ulcer, and have approximately the same fatality and disability rate.

Infection of the gallbladder is due most frequently to colon bacilli from the intestine; less often, to infection from the respiratory tract or other regions. A predisposing factor may be continued abuse of the digestive tract by taking too much food at a time, and especially too many rich, fatty foods. It is common especially in those who like to eat but do not like to exercise. The rate among women is higher than among men. Pregnancy and tight clothing around the waist may cause pressure on the gallbladder, which interferes with its function and increases its susceptibility to infection. Symptoms of gallbladder inflammation in the early stages are those of indigestion—frequently described as dyspepsia or a "bilious attack." Treatment by medical means is sometimes effective; more often, surgery is necessary in chronic infection.

Gallstones are very likely to occur from the same causes as gallbladder infection, and at the same time. They form in the gallbladder when bile is altered in composition or does not flow as freely as usual, and its salts pass out of solution and collect in small particles, which may grow

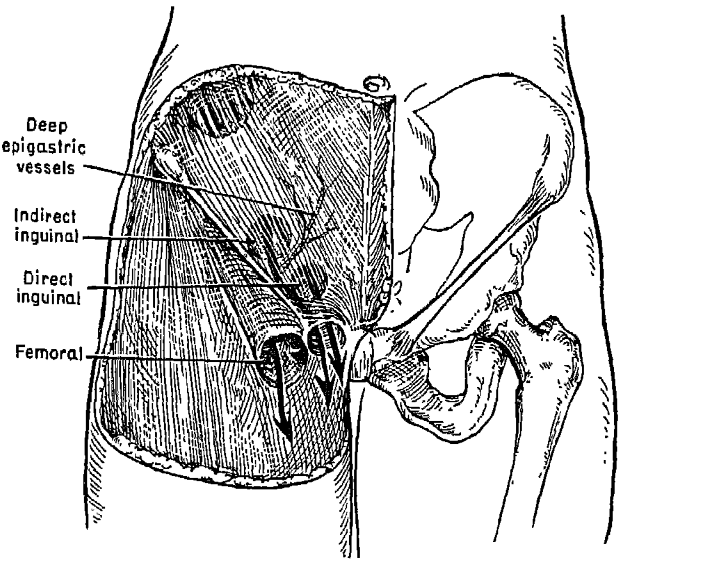
larger in snowball fashion. At times, gallstones pass through the bile duct, thereby causing severe pain, gallstone colic. If a stone obstructs the duct, jaundice also occurs from back pressure of bile, which enters the blood. There is no known way of dissolving gallstones. When present, they must usually be removed surgically, together with the gallbladder if it is diseased.

Hernia and Intestinal Obstruction

This combination of diseases ranks high among the causes of death. In 1947, a total of 10,764 deaths were ascribed to these causes. Hernia was fifth among the causes of disability as disclosed by the National Health Survey.

Hernia (popularly known as "rupture") was fully defined by Celsus, about 100 A.D., as a "protrusion of a loop or knuckle of an organ or a tissue through an abnormal opening."

The abnormal opening may be a natural opening that for some reason is wider than normal. The commonest hernias are those that pass through the inguinal canal in the groin, which normally carries the spermatic cord in the male and the round ligament of the uterus in the female. Next in frequency are the hernias that pass through the femoral canal (also near the groin) which carries the femoral blood vessel to the leg. The



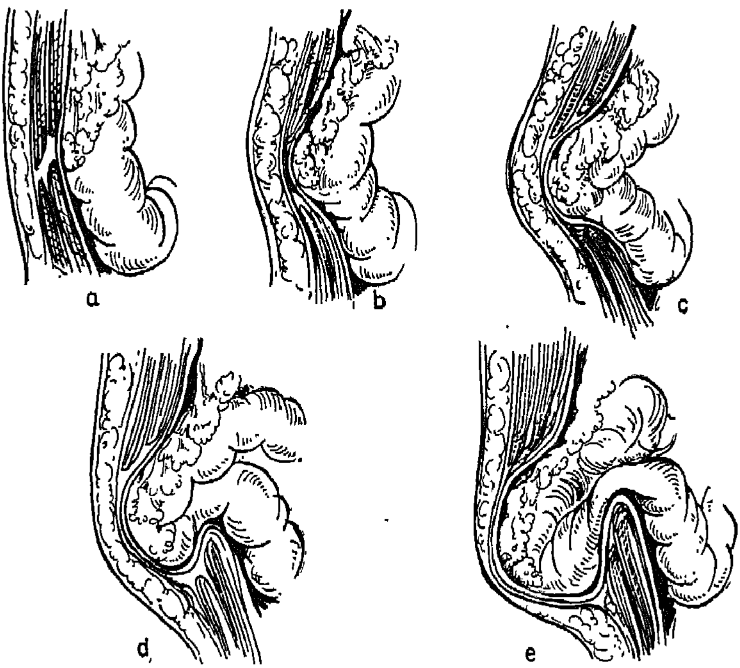
The three most common sites of hernia are: (1) Femoral, (2) direct inguinal, and (3) indirect inguinal, which are shown here with their points of descent.

spaces through which these structures pass may be congenitally wider than usual, in which case even moderate strain, such as hard coughing or lifting, may create enough pressure from within the abdomen to cause part of the intestine to protrude.

Another common site of hernia is at the umbilicus (navel); it usually appears shortly after birth. Occasionally, hernia occurs through an abdominal scar after a surgical operation, if the muscles are strained before the scar becomes firm. More rarely, hernia occurs through the diaphragm, part of the stomach pushing its way up into the thorax.

A hernia is called reducible when the protruded part slips back when the person lies down, or can be pushed back with gentle pressure. In such cases, a bandage or a truss worn constantly may hold it there. More often, an operation is necessary to narrow the hernial opening.

The danger of hernia is that the protruded part will be pinched in such a way as to shut off its blood supply (strangulated). Such a condition is



Progressive stages of hernia. (a) Intestine is in normal position with normal abdominal wall. (b) Weakened abdominal wall with intestinal pressure causing slight bulging. (c) Definite weakening of abdominal wall with sac-like formation. (d) A pouch-like formation of abdominal wall filled with intestines. (e) The herniated wall contains loop of intestine extending through a narrow opening and cutting off most of blood supply; this is known as a strangulated hernia.

very serious, for gangrene may occur. Immediate operation is necessary if life is to be saved.

A person who has a lump on the abdominal wall, or in the groin, or the scrotum—whether the lump is painful or not—should be examined. Most hernias come and go; they should be treated so that they do not come.

Cirrhosis of the Liver

From various causes, the proper cells of the liver may be replaced by fibrous tissue. Because of the yellowish appearance this gives the liver, the disease is called cirrhosis (yellow). In 1947, it caused 14,940 deaths in the United States. The type due to alcoholism is the most frequent. Syphilis is the cause in some cases. Both of these types appear most frequently in the fifth decade of life. An uncommon form of the disease, thought to be due to infection of one sort or another, occurs in young people.

Asthma and Other Allergic Disorders

The term allergy means altered energy, or altered reaction. The individual who is allergic to something reacts in a different way to it than he did when first exposed to it, and different than other persons who are not allergic to it.

The reason for the altered reaction is a sensitization produced by first exposure. The substance acted as an antigen, to excite changes in body tissues, much as bacterial antigens excite changes resulting in the formation of antibodies. But instead of producing immunity an antigen may produce greater sensitivity, and that is what occurs in those who become allergic to a substance. When causing allergy, an antigen is called an allergen.

As for the substances that may produce sensitization, the list is very large. It includes pollens, plants (e.g., poison ivy), dusts, foods, drugs, chemicals, cosmetics, feathers, animal furs and emanations from animals, insect bites and stings, and molds and fungi. A person may be sensitive only to one specific substance or to many.

The tissues in which reactions are most likely to occur are the skin, as hives (urticaria), eczema, inflammation, or swelling; and the respiratory tract, as hay fever and asthma.

Since the tissues are sensitized by their first contact with the substance, special care should be taken with children to introduce them gradually

to new substances, rather than to overwhelm them at their first contact; and to follow the first contact with another contact after not too long an interval. In respect to foods, the child should be given a minute amount of a new food (e.g., egg, to which allergy is common) the first time, and within a week a slightly larger amount, and so on.

After an allergic reaction is established, it may sometimes be determined, by skin and other tests, precisely what substance is exciting it. In such a case, three courses are open: the individual may avoid that substance if it is practicable to do so; or he may be reëducated to it (by graduated exposures to it); or he may be inoculated against it. The latter method is often effective against pollen hay fever and poison ivy dermatitis.

Treatment during an attack of allergy usually includes the use of a drug (adrenalin) that narrows the caliber of the blood vessels in the skin and mucous membranes, and dilates the bronchioles.

Asthma is the only allergic disease that accounts for many deaths. In 1947, asthma was given as the cause of 2712 deaths, although some of these were undoubtedly due to heart disease rather than to allergy. The report of the National Health Survey classed asthma and hay fever together, and placed them in fourth position on the list of disabling diseases, with an estimated three and a half million persons thus afflicted.

Rheumatism and Other Joint Disorders

The condition called rheumatism is chiefly chronic arthritis (joint inflammation). Other structures in or near joints (tendons, bursae, and fibrous tissue around muscles) may also be affected so as to cause similar crippling.

The National Health Survey showed that rheumatism prevails more widely than any other disease; is second only to mental disease in causing disability and chronic invalidism; and is fourteenth in causing death.

The most crippling form of the disease is rheumatoid arthritis. It begins before the age of 40, especially in those who are "run down" by overwork or poor nutrition or chronic infection. Both prevention and treatment involve care of the general health.

Another common type of rheumatism (osteoarthritis) occurs chiefly in later life. In many cases, the joints involved have been injured either by accident or by excessive use (e.g., the hands of the manual worker) or by use at a disadvantage (e.g., the spine and knees in those whose body alignment has long been imperfect). Because of the extra burden

obesity places upon the joints, the obese are especially susceptible to this disease.

A third type of rheumatism is due to gout, a disease associated with disordered uric acid metabolism. Chalky deposits of sodium urate are formed in the joints, and often in the external ear. (Gout is not due to eating acid food nor to acidity of the stomach, nor to any "acid condition" resulting therefrom; nor are any other forms of rheumatism.)

A fourth form of arthritis is due to infection in a joint. The organisms of gonorrhea and syphilis are especially likely to attack joints. Others may do so, as, for example, when a wound causes an opening into a joint, through which pus germs enter. Actual infection of a joint is likely to destroy joint tissues and cause crippling.

When a joint becomes painful, stiff, and swollen, the difficulty may not be in the joint but in surrounding tissues. Over several of the large joints, such as the shoulder and the knee, is located a small sac called a bursa, which normally contains a little fluid. The bursa serves to protect the joint and to ease motion. When injured or infected its surfaces may adhere, causing motion to be very painful. The condition is called bursitis. Treatment is urgently needed to avoid crippling.

Over nearly all joints extend tendons of muscle. If a tendon sheath is injured or infected it may adhere to the tendon, which prevents the tendon from sliding smoothly through it. As a result, the joint beneath the tendon is deprived of motion. Since tendons are often near the surface, tenosynovitis is not uncommon from minor injuries. A stiff finger, for example, may follow a pinprick, unless the first signs of extending inflammation are heeded.

Over each muscle and between the muscle fibers is fibrous connective tissue. If this becomes inflamed, contraction of the muscle is limited, and motion of the joint controlled by that muscle is correspondingly limited. "Stiff neck" upon awaking in the morning, and lumbago after having a draft blowing upon the back, are usually due to this cause. Ordinarily this condition (fibrositis) recovers promptly, but may become chronic and deforming.

Paralysis of muscles because of disease of the nerves to them, as in infantile paralysis and some forms of neuritis, results in crippling, and as a secondary result, the joints undergo strain in use, or weakening from disuse. Orthopedic advice should be obtained and followed.

Prevention of crippling conditions in joints and associated structures is to be sought by various means. Special attention should be given to

avoidance of infection of any and all sorts, avoidance of exposure of the body as a whole and of joint structures in particular to chilling; maintenance of good nutrition and correct weight; avoidance of strain as well as of accidental injury of joint structures; and correct mechanical use of the body.

As for treatment, in many of the acute cases of the various diseases mentioned, early treatment may prevent crippling, when delay even for a few days might make treatment futile. In chronic rheumatic disorders, treatment is often not very satisfactory, although it has been the subject of much research. However, each case should be given the benefit of expert medical advice, especially that of the orthopedic surgeon (specialist in diseases of bones and joints). If cure cannot be brought about, at least greater comfort and better use of the joints can often be secured by mechanical appliances, surgical treatment, and medical treatment.

It should be noted that rheumatic fever was not mentioned above as one of the causes of "rheumatism." This disease involves the joints temporarily but seldom permanently. It is far more likely to cripple the heart than the joints.

Part 4

Mental Health

14
Health of Brain and Nerves

The Brain and Intelligence

The brain is the center through which is mediated everything that goes to make up the conscious life. In it are centers for sensations from within the body and from the environment, and centers for all the various forms of action of which any part of the body or the individual as a whole is capable.

Mental life is founded upon an organic biologic basis—the sensory-motor experience of the body—a substratum common to all living things. Upon that substratum is built, in man, all the varieties of conscious experience, including thought and emotion. The mental life depends fundamentally upon having a brain with certain characteristics of structure and corresponding possibilities of function.

The Cortex of the Brain. The distinguishing characteristic of man is the relatively large proportion of the brain comprising its outer layer or cortex. In the simplest brains, the forebrain (corresponding to the cerebral hemispheres in higher animals and man) is small and its cells are merely clustered together in groups called nuclei. In more highly developed brains, the size of the forebrain becomes relatively larger in proportion to the midbrain and hindbrain, its cortex becomes relatively thicker, and in the cortex the cells become arranged in orderly layers—all of which increases the possibility of the sort of adaptive responses known as intelligence.

The surface extent of the forebrain in fish is 19 per cent of the whole; in rabbits, 68 per cent; in the dog, 72.5 per cent; in the gorilla, 87 per cent; and in the human child 2 years old, 90.5 per cent.

Characteristics of Cortical Response. Through the spinal cord and through other parts of the brain where the nuclear arrangement of cells

exists, responses are immediate and automatic, but through the cortex the response to stimuli may be delayed and of greater variety, and may be chosen with a view to suitability.

That does not mean, however, that all voluntary acts are the result of elaborate cortical activity. In fact, many of them are as immediate and automatic as reflexes. For example, if the stimulus happens to be a dime lying at one's feet on the sidewalk, the response may come immediately in the act of leaning to pick it up. Such acts are impulsive; a simple stimulus sets up neural activity which travels over a short and direct path to the neurons that bring the response.

Scarcely less automatic are the responses conditioned by past experience. Presumably, everyone is conditioned to pick up money lying at his feet, and conditioned against picking up food, from which one equally automatically turns aside.

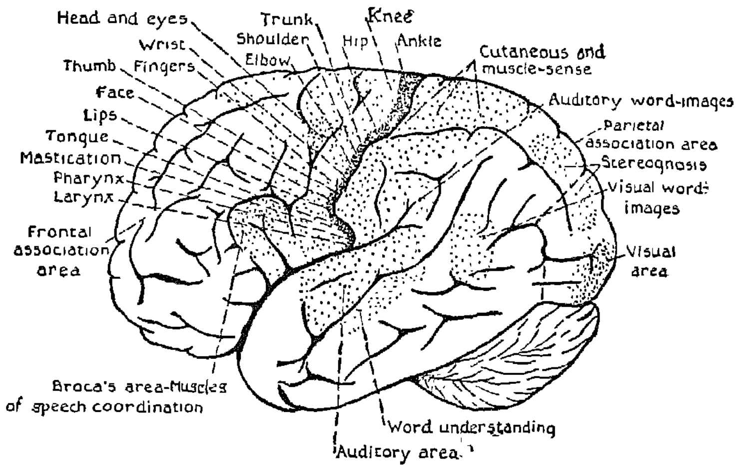
Some voluntary acts appear to be in a somewhat different category—not impulsive, but reasoned. For example, if a dime were lying in the mud or the individual had a lame back, the dime stimulus might be accompanied by the idea that one would soil his hands or hurt his back, and the ideas might sidetrack the impulsive response. He might react, not to the dime, but to his ideas. This is the sort of voluntary response that is typical of higher cortical activity—checking impulsive responses and initiating responses based upon facts and reasoning.

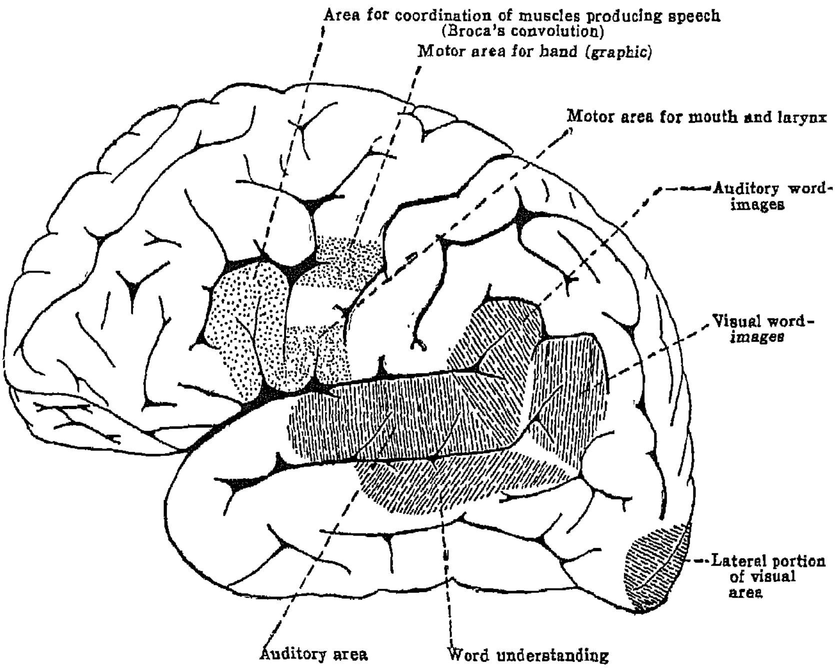
Process of Thinking. A distinguishing characteristic of the cerebral cortex is that its cells have a vast number of processes, and that it contains a vast number of association neurons. These two factors make for a wide variety of possible responses to any stimulus.

Still more significant, the number of stimuli activating cortical responses is infinitely increased by the ability of the cortex to store past impressions. It therefore reacts not only to present stimuli, but to those received in the past—and to any combination of any past or present stimuli.

The storage of impressions is due to the fact that when a stimulus has caused nerve impulses to pass over a given pathway once, the same stimulus is likely to cause impulses to pass over the same pathway again. This accounts for memory and recall. Much thinking is simply remembering—as, for example, in the case of a student reciting a lesson verbatim, or the man who remembers his lame back and does not stoop over to pick up a dime.

Sometimes, however, thinking is a more elaborate process; old and





(*Top*) Areas of functional localization in the cerebral cortex. Lateral view of left cerebral hemisphere. ("Anatomy of the Nervous System" by O. Larsell, D. Appleton-Century Co., Inc.) (*Bottom*) Convex surface of left cerebral hemisphere with diagrammatic presentation of the areas suggested as concerned with speech.

new impressions become associated in new ways, and a new concept results This may be the result of chance or it may be the result of a deliberate attempt to form new associations among neurons (creative imagination and logical thinking). One may direct the train of thought so that it wanders not idly but purposefully; not in a hit-or-miss fashion, but in ordered sequence. From imagination and logical thinking come art, science, philosophy, as well as many of the successful, everyday adaptations to conditions of living.

To summarize, this superior power of the human brain depends upon the large number of elaborate neurons in the cerebral cortex, the kind and variety of association neurons that have been used in the past, the keenness of the sensory perceptions, and, finally, upon practice in directing the train of thought.

What Is Intelligence? Intelligence is generally understood to mean the ability to learn, remember, and reason. More specifically, intelligence may be said to be:

1. The ability to profit by learning, not merely to learn.
2. To correlate what is learned, so as to see relationships between cause and effect.
3. To compare this with that so as to see differences and resemblances.
4. To detect flaws.
5. To appreciate values.
6. To formulate theories and hypotheses, and ways of testing them.
7. To assemble the evidence needed to solve problems—to bring the unknown into the realm of the known.

Briefly, intelligence involves the ability to deal with reality constructively and creatively, and to live adaptively.

Intelligence is not entirely a matter of the cortex. It may not be present in those whose cortex is so constituted as to permit it. Nevertheless, it cannot be present without a cortex of specified type and condition.

Testing Intelligence. Until this century, there was no method of assessing an individual's intelligence other than by observing his verbal and motor responses in various life situations. This method is often highly satisfactory, for adaptation to life situations is the most genuine test of intelligence.

In childhood, however, the individual does not always disclose his native capacity unequivocally. Charles Darwin, for example, was considered by his teachers to be distinctly below average in mentality. The need for other than personal judgments in the case of children led psy-

chologists to devise formal mental tests. By testing large numbers of children of different ages, norms have been established; these are stated in terms of mental age. A child would have a mental age of 10 if he passed the 10-year tests. If his chronologic age were 10 he would be judged to have normal mentality.

The intelligence quotient is the mental age divided by the chronologic age. If a child of 10 passed the 12-year tests his I.Q. would be 1.2 or, as more commonly stated, 120 (the number 1.2 carried to two points to the right of the decimal and the decimal point omitted). By technical methods, the results of nearly all mental tests may be stated in terms of mental age and intelligence quotient.

The same tests may be used for adults, but beyond the age of 16 the chronologic age is still stated as 16. Specific tests are, however, available for measuring adult capacities.

In groups it is often of value to rate individuals according to their relative standing in the group, each individual having a rank in one or another decile (tenth) of the group.

Mental tests do not take into account the emotional and environmental factors that may prevent a person from scoring as well as he might under other conditions; but neither do the informal tests of life situations. Repeated tests by various methods usually give consistent results, and these usually correspond to the individual's customary responses in everyday life.

Feeblemindedness. The term feeblemindedness is used to describe levels of intelligence below normal range. These levels may be specified in terms of I.Q. or mental age, or by the terms dull normal; moron, mental age from 7 to 12 years; imbecile, mental age from 2 to 7 years; and idiot, below the level of 2 years. It is hardly justifiable, however, to compare defectives with normal children at any age, for the mental performance of defectives differs in quality from that of those who are simply immature.

Feeblemindedness may be either hereditary or acquired. The lesser degrees are more often hereditary and the greater degrees acquired. When hereditary, feeblemindedness is a recessive trait—that is, an individual who is not himself feebleminded, may transmit it to his children if he and his partner lack the genes for normal-mindedness. Hereditary possibilities are illustrated on p. 417.

The causes of acquired feeblemindedness are numerous. During prenatal life, or at any time before full development of the brain has oc-

curred, disease or injury of the brain may delay or prevent mental growth. Among the infections, congenital syphilis is of major importance.

Mental deficiency obviously is a problem of preventive medicine, since many cases occur unnecessarily. As for cure, the prognosis is not good except in a few types (e.g , cretins, whose mental defect and general condition is due to lack of sufficient thyroid secretion). For the most part, the solution is in the field of special education, to develop whatever powers the feebleminded may have; often they may be fitted to earn a living. Institutional care usually is required for those below the mental age of 7, and for the higher grade defectives if their defect leads to asocial behavior.

Disorders of the Brain

Effects of Brain Damage. According to the location of a lesion, any cerebral function may be disturbed. Injury to the vital centers (heart action, respiration, etc.) will disturb the corresponding function, and, if at all severe, will cause death. Lesions of the motor area of the cortex may lead to convulsions (spasmodic contraction of muscles, as in the disease epilepsy), or to paralysis of skeletal muscles. In the various sensory areas, corresponding senses will be impaired or destroyed. Lesions of the cortex in any area, and perhaps especially in the frontal lobe, are likely to affect the mind. Diffuse damage, or damage anywhere in the brain, may have the same effect.

The location of some of the cerebral centers is shown on p. 317. These have been mapped out by laboratory research, and by clinical observations verified by surgical operations, x-rays, electrical tests, or postmortem examinations.

How May the Brain Be Examined? Disorder of the brain is diagnosed by examination of the entire body. Of special importance is examination of the various sensations; the motor apparatus; the sensorimotor reflexes; the organ reflexes; and the mental processes. In some cases, the measurement of electrical potentials generated by the brain ("brain waves") gives valuable information.

Relation of Brain to Mental Health. The brain is dependent upon receptors to bring it the "material" for cerebral processes of thought. Disconnected from the rest of the nervous system, the cerebrum would be as futile as a telephone exchange with no wires entering or leaving it. And this is true even though the brain does generate energy and does initiate impulses.

In turn, the whole nervous system is a unit in the larger whole, the body. Cerebral function is interrelated with every part of the body, and the actual content of the mind is in large part the product of sensory impressions from the body and its activities.

Finally, the human organism does not live in a vacuum but in an environment of persons and things, acts and events. Therefore, interrelationships with the world outside itself affects every part of the body and every mental process, directly or indirectly.

Any consideration of mental health must take into account the widespread foundation of the mental life—which is a product of the nervous system, of the entire body, and of the entire environment. Obviously, the mental life is modifiable in countless ways. Nevertheless, the cerebrum occupies a strategic position in mental life. If it is too much injured, life itself stops; if it is less seriously injured, the mind may be proportionately injured.

Brain, Mental Disease, and Bodily Health. Infection of the brain accounts for a large proportion of mental disease. Bacteria may cause inflammation of the brain (encephalitis) or of the meninges (meningitis), either of which may affect the mind. Syphilis is by far the commonest bacterial cause of mental disease.

Injury of the brain by mechanical violence, if it does not cause death, may affect the mind. This is particularly likely after depressed fractures, but it may occur apart from fractures if hemorrhage within the skull occurs.

Chemicals may cause acute or chronic poisoning affecting the brain and impairing the mind. Alcohol taken in any but the smallest amounts at a time gives a temporary mental disturbance; chronic alcoholism often leads to continued mental disease (10 per cent of new admissions to mental hospitals are due to alcoholism, and in many other cases alcohol plays a part). Some of the other narcotic drugs (e.g., morphine) and hypnotic drugs (e.g., barbital) may produce temporary or permanent derangement. In some cases of mental disease caused by chemicals, the condition improves when the use of the drug is stopped, while in others the damage remains.

Tissue changes originating within the body may involve the brain to such an extent as to cause mental disease. For example, the brain cells may undergo atrophy as a result of senility, in old age or prematurely. Also, they may degenerate as a result of poor circulation to them, as in arteriosclerosis of the blood vessels of the brain.

New growths (tumors, benign or malignant) may affect the mind by pressure upon the brain. If a tumor is malignant, its destructive nature adds to the probability of mental disease.

When mental disease is due to demonstrable physical causes affecting the brain, it is known as organic.

Psychosis

The term psychosis means illness of the mind. Illness of the mind implies its lack of capacity to fill its role of promoting adaptation to the conditions of living.

The term insane is a legal one; it is applied to the mentally ill who require custodial care and whose condition warrants their commitment by the courts to a mental hospital.

As stated, when a psychosis is due to bodily conditions it is called organic. But in many cases no such cause can be discovered; such psychoses are called functional, the implication being that so far as can be determined, only the function and not the structure of the brain is disturbed.

Causes of Functional Psychoses. Often a functional psychosis appears to be due to mental causes—that is, psychogenic (*psych-*, mind; *gen*, produced by). It seems very much like a simple exaggeration of bad mental habits such as normal persons may have in lesser degree. For example, the suspiciousness that is so pronounced in one of the functional psychoses is ordinary suspiciousness greatly magnified.

On the other hand, the symptoms of mental illness often seem a simple exaggeration of states of mind such as the normal may experience in response to physical disorders. For example, the depression which becomes profound in some of the mentally ill is very much like that which any normal person may feel at times of great fatigue or illness, differing only in degree.

From the results of two different forms of treatment, it appears that both mental and physical conditions may be responsible for these psychoses. Mental hygiene seems to have had a favorable effect in preventing psychotic tendencies from developing in some; and psychotherapy appears to have cured others. On the other hand, treatment of the body by physical hygiene is needed in some cases; and treatment by medical means is often brilliantly successful in cure (e.g., by metrazol and insulin).

The facts regarding mental treatment point to disordered mental

processes as possible causes of at least some cases of functional mental disease; and the facts regarding physical treatment suggest that disordered metabolic processes may have a causative relationship to disordered mental processes.

Is Mental Disease Hereditary? Obviously, organic mental disease due to brain damage acquired during the lifetime is not passed on to offspring. Some of the functional mental diseases, however, may be hereditary. Certainly they tend to "run in families," and it is believed that they are hereditary in the sense that individuals in families having this type of mental disease are predisposed to it. Nevertheless, preventive measures along the lines of both physical and mental hygiene, and an environmental situation within the range of the individual's adaptive powers, may be successful in preventing even the predisposed individual from actually becoming mentally ill.

Aspects of Psychosis. The manifestations of psychosis are in the sphere of (1) the intellect, (2) the mood or emotions, and (3) the content of thought. Behavior is correspondingly affected.

1. Intelligence is often somewhat impaired, as shown in weakening of memory or ability to concentrate, or confusion about time, location, and persons. In some cases dementia occurs, a form of feeblemindedness which represents loss of mentality from a previously higher level. In several types of mental disease, intellectual ability remains the same, although the capacity to use it is reduced; the mind may be thoroughly disordered without affecting the intelligence quotient.

2. Frequently, if not always, the affective or feeling aspect of the mental life is altered. The mood may be elation or depression, so intense and persistent as to dominate life. Sometimes the mood is one of apathy or deficiency of feeling; or the emotions may be inappropriate to the situation, minor matters arousing as much emotion as important ones. Other emotions that may prevail are irritability, anxiety, anger, and silliness.

3. In another type of mental disease it is chiefly the content of thought that is altered. It may contain material that is not based upon reality. The patient may hold a belief that is contrary to all demonstrable evidence—as, for example, that he is a candidate for the presidency. Such false beliefs are known as delusions. Or he may have false sensory impressions, as of sight or sound, not originating in anything in the environment visible or audible to others. These are called hallucinations. Some normal persons have experienced these phenomena, perhaps during an illness with fever, or in the half-waking half-sleeping state.

In general, a psychosis causes profound changes in the personality, and the individual becomes "not himself." To the normal person, his ideas, feelings, and behavior seem "strange" and "unreasonable." Often, however, the abnormalities are not all conspicuous, especially when intelligence is not impaired. The person who is mentally ill may himself be aware of it. He should, of course, place himself in expert hands for treatment.

Spinal Cord and Nerves

Like the brain, the spinal cord and the nerves are subject to injury from the same variety of causes that affect other organs. Since the nerves are motor or sensory, and since the spinal cord carries fibers that conduct motor and sensory impulses, the symptoms of disease of the spine or the nerves will be disturbance of either motion or sensation or both.

Irritative lesions may cause an increase or a change in the character of motion (e.g., tremor, twitching) or of sensation (pain, peculiar feelings, etc.). Destructive lesions cause partial or complete loss of motion (paresis, weakening; or paralysis) or of sensation (partial or complete anesthesia of a part). The symptoms occur in the part of the body supplied with motion or sensation, by the particular nerves involved, or the particular segment of the spinal cord from which these nerves come.

1. Spinal Cord. Among the common diseases involving the spinal cord is poliomyelitis, an infection which involves the cells of motor nerves, usually in the spinal cord, causing paralysis (called infantile, although it may occur in adults). (See p. 256.) Another is multiple sclerosis, in which patches of hardening occur in the cord and elsewhere in the nervous system. This disease is an even more common cause of paralysis than poliomyelitis. A disease known as shingles (herpes zoster) is due to a virus infection of the ganglia containing the cell bodies of sensory nerves. It causes a great increase in sensitivity of the area of skin in which the sensory fibers are disturbed.

2. Nerves. The nerves are especially subject to neuritis (nerve inflammation) from the effect of poisons (e.g., alcohol, lead, arsenic); bacterial toxins (e.g., diphtheria); nutritional deficiencies (e.g., lack of vitamin B); and pressure (e.g., some cases of postural backache, sciatica, and foot pain). Neuralgia means pain in nerves; it may occur with or without neuritis.

Functional Nervous Diseases: Neurosis and Psychoneurosis

A disturbance of the functions of the nerves is no less important for practical living than disease of nerve tissue; for if the nerves do not serve their purpose of supplying properly coördinated stimuli for the regulation of body processes, the result is as bad as if they were so damaged that they could not do so.

Ailments Due to Faulty Nerve Function. Disorder anywhere in the body may exist solely because the regulating system of nerves does not regulate. When any bodily function is not carried on well, the physician thinks first of the organs themselves and makes sure that they are sound. If that is the case, the next question is, why are they misbehaving? And the answer often is, because they are receiving unsuitable nerve impulses.

An example is furnished in the case of the stomach, which may give symptoms of nausea and vomiting when the stomach is diseased (as with ulcer); or when its nerve impulses are disordered as a result of some such causes as the following: reflex disturbance of its nerves by disturbance elsewhere, as from the apparatus of equilibrium in the ear when disturbed by the motion of a rocking boat; physical causes such as extreme fatigue, malnutrition, or illness; and disturbing emotions, such as anxiety, fear, or grief.

Although the stomach is used as an example, any organ may be deranged in its functions for a similar variety of reasons; and although nausea is used as an illustrative symptom, virtually every symptom to which man is subject may be due to imperfect regulation of functions by nerves.

When nothing is the matter except that the nerve impulses are faulty, the ailment is given the descriptive adjective "nervous." This is not because the person necessarily is what is known as "nervous," but because the ailment primarily has to do with the nerve supply of the ailing part.

The layman is likely to think of functional nervous ailments as imaginary or "all in your mind." That is a mistake. The physiologic disturbances, both of motion and secretion, are as real as those of organic disease, and are demonstrable by the same tests. The effect upon the sensory nerves is equally genuine; the pain and discomfort really exist.

Confusion on this point arises from the fact that in some cases the original cause of the very genuine bodily disturbance is a state of mind.

But nervous disorders and "nervousness" are by no means always of mental origin.

"Nervousness." The term nervousness usually is applied to a general overresponsiveness of the nervous system in both sensory and motor respects and in the sphere of the emotions.

The difficulty may be lowered resistance at synapses, the points at which nerve impulses are transferred from one neuron to another. Apparently a number of conditions make it either easier or harder for impulses to pass from one nerve cell to another across a synapse. When the nerves are overresponsive, and the individual is "nervous," or "jittery," it may be because stimuli pass too readily—that is, the threshold at synapses is low. Possibly a chemical material mediating the nerve impulse at synapses is at fault.

Nervousness is always present with hypersecretion of the thyroid gland. Also, it is often associated with illnesses that deplete vitality. In some, it appears regularly during overfatigue or after loss of sleep. Finally, it may be emotional in origin. Persons with "nerves" are likely to have functional nervous disturbances of one organ or another but, as stated, the latter may occur without the former.

What Are Psychosomatic Disorders? Illnesses that are partly mental and partly physical are called psychosomatic (*psych-*, mind; *soma*, body). A person often is mentally not quite "himself" while his body is out of order, nor physically "himself" while his emotions are out of order. In most illnesses, mental attitudes interact with the physical cause of the illness, each intensifying the other. For example, the total illness may be due to a physical cause, such as pneumonia germs, plus a mental cause, such as worry about expenses, or lost time, or the like. Recovery from illness often is slower than need be if the whole body-mind were not involved. Treatment in such cases involves the treatment of both the bodily and the mental state. Wise physicians never make the mistake of considering a patient as a body apart from a mind.

"Battle Reaction." A common type of psychosomatic disorder has been called battle reaction when it occurs in soldiers. Its counterpart often occurs in civilian life. When soldiers succumb to it they usually have been affected simultaneously by extremely trying physical conditions, such as long hours of hard work with discomfort and fatigue, and equally trying emotional conditions, such as fear for the life of themselves and their comrades, and for the outcome of the struggle, and perhaps horror at the brutality of warfare. The soldier may be overcome

both physically and emotionally. Common physical symptoms are: rapid heart action upon slight effort; weakness; sweating; trembling; nausea; and vomiting. Common mental symptoms are: reluctance to associate with other persons; depression; feelings of guilt; bad dreams; and the like.

In military life, treatment consists of removing the soldier from the difficult situation and providing him with plenty of sleep, either naturally or by hypnotic drugs. This alone often starts recovery promptly, but in addition, the physician tries to help the soldier to free himself of any lingering thoughts or emotions which might perpetuate the illness. Many soldiers become able to return again to combat. Some have to be sent home, and these, if they were hitherto normal, will gradually become themselves again.

In civilian life, the same reactions may occur to situations that are physically and mentally almost beyond human endurance, and they may respond to similar treatment.

It should be noted that these psychosomatic disorders may come upon even the most normal person. It is a question of the stress to which a person is subjected, rather than of weakness of personality.

Psychogenic Disorders. Disorders that are due entirely to mental causes are called psychogenic (*psych-*, mind; *gen*, produced by). An example is fainting upon hearing bad news. As mentioned, "nervousness" may be entirely psychogenic. The more serious psychogenic disorders include neuroses and psychoneuroses. These are very common, and have been brought to public attention in recent years because of their occurrence among men in the armed services.

Neuroses or Psychoneuroses? The chief difference between these two is the relative predominance of mental symptoms. In the latter, mental symptoms are more evident than in the former, although the mental cause may be the same in both. The mental cause is fundamentally a type of personality characterized by maladjustment to life and a habitually poor response to life's difficult situations which may be of one sort in particular, or of several sorts, or all sorts. Unsolved mental conflicts usually are at the root of the neurotic personality. Conflicting desires or tendencies create problems the individual is unable to face or solve, although his problems and difficulties may be no greater than those that other persons can meet in adequate fashion.

Neurotic and psychoneurotic illnesses may appear in childhood. For example, a child may react to a school examination by becoming "sick

at his stomach" so that he has to miss the examination. He is not deliberately evading a difficult situation, but escapes it through the physical "upset" which arises when his emotions are upset.

In adult life, a variety of physical symptoms may appear, ranging from trivial to incapacitating. Often the symptoms resemble those mentioned for battle reaction.

The mental symptoms that develop upon conflicts may be a state of chronic anxiety, indecision, fear, obsessions, and the like. The individual may become socially and occupationally inadequate.

A vast number of persons are, to some degree, neurotic or psychoneurotic. It is a question whether such persons possess a constitutional and inborn inadequacy to react in healthy ways to their own impulses and environmental situations, or whether their inadequacy is acquired as a result of early formation of poor mental habits.

Neurotic persons often get along satisfactorily in life, and may even have brilliant careers if their situation happens to be one that will not tax their limited adaptive power. A neurotic person may, for example, succeed as an artist who could not possibly succeed as a salesman, and vice versa.

It should be noted that the same term—psychoneurotic reaction— is applied to "nervous breakdown" in normal persons who break under great strain, and in neurotic persons predisposed to break under slight strain. Treatment is the same when the illness begins, but where the normal person recovers from psychoneurotic reaction, the person whose personality was psychoneurotic at the start remains psychoneurotic, and cannot be cured except by long psychotherapeutic treatment, if at all.

Prevention offers the greatest possibilities, which is the reason for discussing this subject at length. It is worth-while for everyone while young to cultivate the mental habits that lead to mental health.

The Need for Mental Hygiene

It is commonly assumed that if a person is not mentally ill he is mentally well. That is true only if mental health is defined in negative terms as absence of psychosis. But it is a fallacy to define it thus.

Health—mental as well as physical—is a positive state comprising a high level of function. Certainly not all the nonpsychotic are at that high level. In fact, the degrees of mental health follow the normal curve of distribution, with perhaps 10 per cent frankly psychotic, another 10 per cent at a genuinely high level of mental function, and the ma-

jority, perhaps 80 per cent, distributed at various levels between the best and the worst.

If mental health is subject to improvement as a result of giving it attention, then the majority need to give it such attention. It is believed that attention to mental health is profitable for a great many people, and in some cases enables the semiwell to reach the ranks of the well. Also, it may help some of those at lower levels to avoid psychosis.

Mental hygiene consists of methods that have been found beneficial for individual use, and methods appropriate for group or national use.

15

Health of Personality

Mental or Personality Traits

The mental state of the psychotic usually is described in terms of the various mental diseases; that of the nonpsychotic is described in terms of personality traits or personality types.

The word personality came from the Latin *persona,* the mask Roman actors wore as aids in portraying their roles (*per,* through; *sonus,* sound). In modern times, especially in psychiatry, it refers, not to the aspect a person presents to others, but to the actual person behind any mask he may happen to be wearing.

Personality may be defined as the sum of all the traits that characterize a person. A personality trait, therefore, is any single trait that goes to make up the whole.

The terms good and poor are used to describe separate personality traits and total personalities. A good trait is one that makes for better adjustments to life in its various phases. A good personality is one that is adapted to living—one that can carry on life with personal satisfaction and social approval. In this sense, the term good personality is virtually synonymous with mental health.

Good Personality. The mentally well, or those of good or adapted personality, have four outstanding characteristics:

First, the mentally well face facts. They confront reality, even though unpleasant, with equanimity and a suitable response. They do not run away from the disagreeable, nor try to banish it from their minds when it needs attention, nor mope over it; but they try to do something constructive about it. They do not hesitate in their decisions, postpone irksome duties, shun responsibilities, or begin tasks and not finish them, but they confront difficulties, decide and act promptly, and hold a straight

course in overcoming them. They do not indulge in self-pity at their hard lot, nor in corroding envy of those with an easier lot, nor in futile daydreaming of what has been or might be. Least of all do they give themselves over to a pleasure-seeking life, demanding only comfort, amusement, and ease.

Second, the mentally well get along with other people, not only with a chosen few, but with all sorts and in all conditions as occasion arises. They possess a fellow feeling for others of the human race, and sense the interrelatedness of human beings and their responsibilities toward each other. They can have easy, smooth association with others because they are neither timid and shy, nor suspicious, nor unduly touchy and sensitive, nor too managerial, nor too dependent. They are capable of successful coöperation because they are good sports, fair and square in their dealings, and accept the principle of "give and take" between associates.

Third, the mentally well use their powers in significant work that squares with their own standards and those of civilization. The term significant does not necessarily mean big and *important*, but rather having value, or fitting into the picture of civilized life in home and community. The mentally well usually have at least one absorbing interest into which they put a great deal of energy, and from which they obtain much satisfaction. This interest usually centers in the career, but spreads over many other matters. The energy output is large in proportion to the "drive" furnished by the interests. Application to work is not "feverish" in intensity, nor intermittent, but calm and methodical.

Fourth, the mentally well get along with themselves, adjusting their various tendencies and inclinations, and striking a comfortable balance between them. Having brought their forces into harmony, they cease to be dragged first this way and then that, or to be perpetually torn by unrest, discontent, anxiety, and discouragement, but are free as unit or integrated personalities to use their entire strength against such difficulties as arise.

Some of the 80 per cent who are mentally not completely well, are near to the high levels mentioned and are in the main happy and effective and givers of happiness to others, but perhaps not as completely, nor as consistently, as they might be.

Poor Personality. In the extreme, the poor personality is the opposite of the good personality just described, those who lack mental health usually cannot confront or cope with difficulties, are not effective as

members of society, and do not get along with themselves or others. Among the 80 per cent of "average" human beings there are some who are near to this low level, finding life miserable and futile for themselves or making it so for others, or both. The personality may be considered poor to the extent that it does not gain satisfaction for itself while giving satisfaction to fellow beings.

Hundreds of personality traits, singly or combined, are in a varying degree crippling to the mind. From certain combinations of traits there eventuate four well-defined types of personality that are usually, to some degree, crippling.

What Are Four Common Types of Faulty Personality? First, there are the neurotic personalities, often known as "temperamental," many of whom are definitely misfits, but not to a degree that classes them with the psychotic. Some of these have been mentioned in the previous chapter.

Second, there are the markedly cyclothymic personalities (*cyclo,* circle; *thymos,* mood), subject to wide and extreme mood swings between exhilaration and depression. Such moods may be incapacitating at times, more or less briefly; or one mood or the other may steadily prevail, and hamper everyday living. Many persons are mildly cyclothymic and not at all handicapped thereby; indeed, this tendency is often present, although under control, in the gifted and productive.

Third, there are the immature personalities, characterized by attitudes, feelings, and responses normal in childhood but not serving in adult situations. Common traits of this type are: not discriminating between the important and the unimportant; feeling as keenly about trivial matters as weighty ones; demanding attention and praise; showing childish dependence upon others; childish bravado; a tendency to gain their ends by making scenes; not distinguishing between fact and fiction; indulging in daydreaming; and taking naive enjoyment in the pleasures of the senses.

Fourth, there are the schizoid personalities, popularly known as "odd" or "eccentric" or "peculiar," who do not look at things in quite the same way as strictly "normal" persons do, nor react or behave as the normal do. Yet they are not complete misfits; in fact, some of these are specially gifted and make excellent adaptations in limited fields particularly suited to them. It is this group that was responsible for the phrase "genius is akin to madness." Some of the schizoid are "shut-in" personalities, characterized by reticence and seclusiveness. Army medical advisors have

warned that this type of personality is a poor risk in military life. Many persons are somewhat introverted (turned in upon themselves) without, however, being definitely of the schizoid type.

Can the Personality Quotient Be Determined? It would be an advantage if an individual's P.Q. (personality quotient) could be obtained as readily as his I.Q. (intelligence quotient), but personality traits are not as readily measured and rated as intellectual powers.

At the start, difficulty arises in establishing scales of values for personality traits, for a given trait may sometimes be good and sometimes not. Each trait must be considered in relation to the whole individual. The same trait might be hampering to one and helpful to another. For example, a tendency to be "dreamy" might be essential to a poet, but detrimental in the extreme to a traffic policeman, a surgeon, or a salesman.

Some traits always have adaptive value (e.g., promptness) and some never (e.g., suspiciousness). Yet even these cannot be assigned a proportional value and added up to give a valid rating. For example, a person might attain a rank of 97 per cent, and lack only one trait rated at 3 per cent; yet the lack of that particular trait might totally unfit him for adjusting to life.

In other words, virtually any trait of personality may, in given instances, rate 100 per cent. When attempts are made to use mathematics in rating personality, it has been found that the rating an individual attains according to scale may not correspond at all to the state of his mental health as diagnosed by a psychiatrist, and as demonstrated in actual living.

Factors Influencing Mental Health

The burden of this chapter is that personality is modifiable by training, and that, in many cases if not in all, a satisfactory degree of mental health may be attained by means of suitable training at the hands of others in childhood and at the hands of one's self beginning as soon as one reaches the age of understanding.

Before discussing the subject of training, it is important to consider all the other factors that enter into the formation of the personality—heredity, intellect, physical health, and environment.

Heredity and Mental Health. As has already been mentioned, a predisposition to functional mental disease is hereditary. Is the opposite true—is a tendency to complete normality hereditary? Should everyone not

hereditarily disposed to mental disease be able to achieve complete mental health? In other words—are personalities "born, not made"?

The person with a defective personality likes to believe that he was "born that way." He uses the theory to excuse himself, and also to detract credit from those who do have good personalities. All, he argues, are what nature made them, and therefore free of either blame or credit.

It is true that some persons appear to possess mental health and all its satisfactions as a birthright, and that others, strive as they will, cannot attain it. Without any effort *A* appears to be always cheerful, popular and successful, like others in his family; whereas *B* is tactless, morose, friendless and a failure—also like others of his family.

The science of genetics furnishes little information that is useful in advance in determining how far a person can go in development of personality. The only way to find out is by trial.

Agencies for the improvement of mental health and behavior are correct in assuming that the individual hereditary limitations, being unknown in advance, may be discounted, and that the highest hopes be entertained for all, even for those in families prone to mental deviation.

Intellect and Mental Health. The possession of a high I.Q. is not a prerequisite nor a guarantee of stability or soundness of mind. In fact, those with the highest I.Q. may have the lowest P.Q., even to the extent of psychosis. In the extreme, a man of great brilliance and retaining the full power of his intellect may become quite irrational. Although able to think clearly, he may fail to do so, either on some matters or on all. For example, he may be sure that he has a million dollars when he has not a cent. Having brains is not the same as using them intelligently, which means adaptively.

A person may have "brains" and use them cleverly about some matters, and yet be a misfit and unhappy. For example, a research worker in science is so irritable and uncoöperative at home that his wife and children consider him "out of his mind," and do not respect him as the world does.

Not infrequently, a student in college is of the highest rank academically and the lowest rank in popular esteem; and conversely, one of scarcely average brains may endear himself to students and faculty alike, and make a genuine place of honor for himself.

Even though mental health is certainly not an automatic result of a high I.Q., there is the widest possible field for the use of real intelligence, as defined on p. 318, in building up a high P.Q.

Physical Health and Mental Health. The body and mind are not separate. They are all one, inextricably interwoven. Each person is a body-mind. It is inevitable that body and mind should influence each other, as they do. This is commonly recognized. For example, the pessimism and irritability of the weary are proverbial, and the complacent after-dinner mood is taken for granted.

Yet close as is the relationship of body and mind, not all states of mind have discernible causes in physical conditions. With a body that is, so far as may be determined, in exactly the same state, the mental state may vary in a short space of time from exaltation through the whole gamut of emotions to depression; and the behavior from that of a saint to that of a demon.

Furthermore, the effect of illness upon the mind is an individual one. One person becomes "snappish," another "grouchy," another tearful, another excited, and another shows no unfavorable mental symptoms at all. It must be concluded that illness does not cause specific personality traits, but merely brings out those that are potentially present. The mother who concludes that her child is ill when he has a temper tantrum, may be right in thinking that the child is ill, but she is wrong in thinking that illness is the whole cause of the outburst. A temper tantrum is a mental symptom. No one has one unless his mental health is at fault.

Those who are grievously afflicted in body may have excellent mental health; and those in superb physical condition may be mental wrecks. Obviously, the state of mind varies for reasons apart from bodily health. Whatever the state of bodily health, the maintenance of mental health is a technic by itself. This is because the mental life is the product of the body much as sound is the product of a musical instrument; the same instrument played skilfully gives forth finer music than when played by an amateur.

Excluding specific disorders that damage the mind in specific ways (e.g., brain disease and some of the endocrine diseases), it must be concluded that fitness of the body, valuable as it is, does not ensure mental health, and that the phrase "mens sana in corpore sano" (a healthy mind in a healthy body) is somewhat misleading. Nevertheless, health of both body and mind should be safeguarded, each for the sake of itself and the other.

Relationship of Environment to Mental Health. A faulty environment often is mentioned as a cause of poor personality development, and a good one, of satisfactory development. By environment is meant the

total influences acting upon an individual from without—the material surroundings, and the situations and conditions (especially the political, economic, and social).

It appears that any feature of the environment can be considered no more than a contributory factor, not as a causative one, in forming personality traits. And the contribution may be the opposite of that expected; poor conditions may act as a challenge and "good" ones may be softening.

Parents always desire to make life as comfortable for their children as possible, so that they will not have difficulties to overcome, with the attendant worries and fears, hard work, and perhaps failure. But even if such a commendable aim is carried out, it does not ensure their children's mental health. It may make adaptation a little easier for those who intrinsically have little adaptive power, and thereby may keep them from breaking down under a load of adversity. But it may make adaptation so easy for those with potentially great adaptive power that they never have a chance to develop it, and remain vulnerable in any crises that may arise.

Obviously, an environment good for mental health is not necessarily a completely comfortable one, but a constructive one. Certainly everything should be done to make the environment as good as possible in this sense.

Unquestionably, the young growing up in the 1950's will find it difficult to create harmony in their lives and content in their minds. But great as the obstacles are, many of the present youth will—as in generations past—attain and keep mental health.

One set of factors in the environment is particularly potent in influencing mental health, for better or worse—the social factors. The term social comes from the Latin *socius*, companion or fellow, and is used to indicate all the persons in the group to which an individual belongs, and the group itself. A child who grows up in a peaceful, law-abiding family and community of a high degree of culture, is likely to find it easier to develop those traits that make his family and community what they are. The influence of groups upon individuals and of person upon person cannot be minimized. Such influence may be unintentional, or planned for the definite purpose of training, as mentioned in the next section.

Training by Others an Influence on Mental Health. It is the role of the three great institutions—the home, the school and the church—to provide the growing young with sets of ideals and values and sets of

habits whereby they may fit smoothly into life in all its aspects, and enjoy mental health.

Results are achieved in two ways. First, the persons in family, school, and church tacitly influence the child by being what they are. From his humble position the child normally looks up to these persons, considering them better and wiser and stronger than himself, and is impelled to be like them.

Freud has hypothecated an ideal self or superego which develops as a result of early identification with those who are respected. The theory accounts in psychologic terms for the universally observed fact that the young do grow to be like those they admire, and tend to develop within themselves similar standards of behavior.

As time goes on, the young tend to identify themselves not only with the persons they respect, but the institutions themselves, and the principles for which they stand. With many, the supreme identification is with God, representing all the goodness and wisdom and strength they have found in human beings and in nature and all that they can conceive.

Second, the home, the school, and the church add to their tacit influence by direct precept—by calling the child's attention to the types of response that he should cultivate, explaining the reasons for them, and in general eliciting his own understanding efforts on behalf of his better adaptation.

In recent years, the sciences of psychology and psychiatry have done a considerable amount of clinical work along the lines of habit-training for children and personality development for adults. Their greatest contribution has been, however, in making their scientific conclusions available to those regularly in charge of child and adult guidance.

Self-training and Mental Health. By self-training is meant the deliberate effort to train one's self to react in specified ways to specified stimuli, and thereby to develop patterns of response that will thereafter be followed more or less automatically.

To train one's personality to better adaptive levels, there must first be appreciation of the fact that one needs such training and that improvement is a possibility. Second, there usually must be an understanding of certain facts about human nature, from which facts should come a better understanding of one's self, and better understanding of the sort of training one needs. No two persons will require precisely the same methods of mental hygiene, yet people are alike in more ways than they are different, and in all persons the general principles of mental health are the same.

The chief likeness between people is that all feel certain needs and are activated by certain native trends.

Native Needs and Trends

Man's Needs and Urges. Biologically, man is a unit organism, living in association with others, and reproducing his kind. He experiences needs arising from these three characteristics, and develops corresponding trends toward action.

First, he needs to look out for himself as an individual, to make sure that he survives and fulfills himself as an individual; from this need springs the self impulse (seeking self-preservation, self-realization and self-satisfaction).

Second, he needs to associate with others and work with them and fit into the social organism of which he is a part; from this need springs the societal or social impulse (seeking comfortable and mutually satisfying relationships with other people).

Third, he needs to reproduce his kind, and can do so only by union with another of the opposite sex; from this need springs the sex impulse (seeking the relationships of sex, mating, and parenthood).

The self impulse is observable even in organisms at the lowest levels; the sex impulse, in all but the very lowest; but the societal impulse is characteristic of only a few species below the human.

Each of the three major impulses comprises many specific ones, and each of these may be fulfilled in countless different ways. Later sections present the various aspects of the self, the social and the sex impulses.

These three trends or impulses are called native because they are a biologic inheritance. Other names by which they are known are: biologic urges, drives, or instincts; unconscious wishes or motives; manifestations of vital energy or *elan vital* (Bergson) or of *libido* (Freud).

By whatever name they are called, the implication is that they are inborn tendencies to be motivated in these three directions, and to respond to such motivation by striving according to the patterns mankind has long followed. The striving aspect of the mind may be called its conative aspect.

It is because of the feelings or emotions that surround them that the fundamental trends are followed. Needs are characterized by an uncomfortable feeling called dysphoria—a feeling that things are not as they should be. Conversely, the satisfaction of needs gives rise to the pleasant feeling called euphoria—a feeling that all is well.

Dysphoria includes all the unpleasant feelings to which man is subject; and euphoria, all the pleasant ones. Dysphoria ranges from slight unrest to agony; and euphoria, from mild content to ecstasy.

Whenever dysphoria is present or feared, or whenever the possibility of euphoria is sensed, the impulse arises to do that which will banish the dysphoric feelings, set things right, satisfy the need, and establish euphoria. This fundamental tendency to replace dysphoria with euphoria is manifested in many physical ways (e.g., to replace the pangs of hunger with a satisfied appetite), and in many psychologic ways to be mentioned.

The emotional or feeling aspect of the mental life may be called its affective aspect.

Is One Always Aware of Motivating Forces? One is necessarily aware of the feelings and emotions that accompany a native urge and cause action. But one is by no means necessarily aware of the psychobiologic need the feeling represents, nor the true reason for the act it produces. Many an act is no more meaningful than is eating as in the case of the child, who knows nothing of digestion and nutrition, but only that it feels like eating.

The unconscious mind has been hypothecated as comprising all the motivating forces of which one is either not aware at all, or is aware of but does not understand. It provides the obscure motives behind, for example, a strong preference for a particular career, or an "instinctive" dislike for a certain person, or an "impulsive" lie.

The term complex is applied to unconscious motivating forces specific in a given individual, as a result of personal experience that aroused a great deal of emotion. The original experience may have been forgotten at once but the emotion persists or recurs in full force when the original stimulus is repeated.

A complex causes one to have strong emotions on a matter that apparently does not warrant it (as in the case of a man who had so unreasoning an antipathy to redheaded women that he could hardly be in the same room with one, the complex having originated in the terror aroused by a domineering redheaded teacher he had long since forgotten). Also, it may cause one to perform apparently meaningless acts (such as stepping on every crack in the sidewalk), or acts contrary to one's established standards (such as purposeless compulsive stealing, as in the kleptomaniac). There are, however, as many useful or harmless complexes as harmful ones. A person's extraordinary interest and zeal in his life work

may, indeed, be the product of a complex. Nearly all absorbing hobbies have such a foundation.

A given individual may be unaware of nearly everything that motivates him—that is, be governed almost entirely by his unconscious mind. But just as it is possible for the child to learn to understand what hunger and eating mean, so also is it often possible and suitable to learn to understand what other feelings and impulses mean. The cognitive, or recognizing, aspect of the mind can usually bring the individual not only an understanding of the world about him, but also, to a practical extent, even of his own self.

Differences of Individuals. Individuals differ from each other in the particular urges that activate them most strongly, and in the particular modes of reaction they develop in response to these urges. In other words, although the three major forces are the same in all, there are as many different personalities as there are persons.

Also, individuals differ within themselves from time to time in their lives, as a result of increasing experience. Often a person needs to look back only a short time to be surprised at the change in his objectives and his methods. Normally, the difference is in the direction of growth and stability of personality.

Some individuals, as has been mentioned, never attain a unified personality, but differ from day to day, or even from moment to moment, scarcely knowing what sort of persons they are, what they really want, or what they are likely to do. Such a state of affairs results when two or more motives come into conflict and the conflict is not solved.

Mental Conflicts

From their very nature it would be expected that the three major trends would at times conflict with each other. Obviously, what one desires for one's self-satisfaction may not be at all what one should do to keep on good terms with one's associates and to serve the group welfare. Self-social conflicts begin virtually in the cradle and last through life in those who do not learn to solve them. During the greater part of life, a third warring component, the sex impulse, shares the field and strives for victory over both self and social impulses.

It is equally obvious that two specific urges within any of the three major trends may come into conflict. Two self impulses, for example, may point in diametrically opposite directions—as in the case of those who desire wealth, but are drawn toward a career in which the rewards are

not pecuniary. There is also the possibility of conflict regarding ways of satisfying any specific urge. For example, if scholarship and athletics both appeal as fields in which to excel, a bitter conflict may arise—one which many students do not solve during their entire school life.

No one is entirely free from conflicts, or can hope to be so. But one can hope and expect to learn the technic of solving them as they arise. Unsolved conflicts are abhorrent to the personality and paralyzing to effectiveness. In fact, they are at the root of many of the neuroses and contribute to some of the functional psychoses. In general, motives tend to be acted upon in one or another of the ways to be mentioned.

Motivation and Conflict Solving. In the very young and those of immature personality at any age, motives tend to fulfill themselves. An impulse and an emotion are felt, and action follows. Such impulsive behavior may be called emotionally determined.

Thought often takes part in determining an act, but the act must be classed as emotionally determined if thought is used only as a means of obtaining easy and immediate euphoria, regardless of methods and consequences (e.g., cheating to pass an examination).

Cortical activity—even though used to help direct the fulfillment of an urge so as to obtain euphoria—is most effective when it gives due regard to the appropriateness of the method and the value of the results.

When impulses are strong, and especially when conflicts exist, emotionally determined behavior is likely to take place; there is a tendency to do any obvious thing that will bring the desired euphoria. In such circumstances, the mental mechanisms to be mentioned in the next section often come into use. But at such times—indeed at all times—adaptation to living may be handicapped unless the impulses are given suitable cortical direction, as suggested throughout the remainder of this chapter.

Mental Mechanisms

In the presence of situations that are causing, or threaten to cause, dysphoria, persons are prone to execute certain mental maneuvers to set things right. These are called mechanisms because they tend to occur as mechanically as, for example, the ringing of an alarm clock at the time for which it was set. They may also be carried out deliberately.

Like the neuromuscular reflexes (e.g., the automatic closing of the eyes when a cloud of dust approaches), the mental mechanisms serve an immediately useful purpose. The purpose they serve is that of defending

or protecting against something unpleasant, and thereby bringing euphoria. They are often called defense mechanisms; viewed in relation to the results, they are really mechanisms for euphoria.

The mental mechanisms do not always, however, serve the purposes of the personality as a whole. Comfortable feelings are their sole aim, and they are not selective as to suitability. Some of them regularly produce behavior so unsuitable that still greater dysphoria is likely to arise at once, and a genuinely satisfactory adaptation becomes still more difficult. Some produce behavior that is socially acceptable, but does not adequately meet the needs of the personality as a whole. A few may have great value, and one—the last to be mentioned—is of supreme value.

Rationalizing. A common mechanism probably used by nearly everyone nearly every day is rationalizing, or reasoning to order, the orders coming from the emotions. By rationalizing, one manages to think what one feels like thinking. One may "think up" arguments to make any act or opinion seem reasonable and right. For example, by rationalizing one may convince one's self that at the moment one needs recreation rather than more work, or that more work would be futile.

The two processes, reasoning and rationalization, make use of the same cortical powers of thought, but they differ in that reasoning is based upon facts unbiased by emotion—"cold" reasoning, it is sometimes called. Reasoning is man's most useful tool for making adaptations at high levels, whereas rationalizing is man's most useful tool for preventing just that, since it enables a person to be satisfied with himself whatever he does.

Rationalization often takes place after an act has been done on an emotional basis, to justify it, but it may take place in advance, and seem exactly like reasoning. It is not always easy to be certain whether one is reasoning or rationalizing when making plans, for the "wish" element in rationalizing may not be clear. Nevertheless, nothing is more important than to be certain that one is not misguided by one's adroitness in making "the wish the father of the thought." One test is whether one's ideas can be changed upon the presentation of new facts, or only when the feelings change. "A woman convinced against her will (or wish) is of the same opinion still." Pope's observation, true as far as it goes, is in itself an example of rationalizing; he preferred to believe that males were always reasonable.

Forgetting. Of course, much forgetting is due to a poor memory or to chance, but often forgetting is a purposeful mechanism. If a thing has been

forgotten, nothing need be done about it. Forgetting therefore frees one of certain obligations, and rids one of annoyance—at least for the time being. Forgetting also serves other purposes. For example, a person may repeatedly forget the name of someone who reminds him of his own shortcomings, or of unpleasant situations. Also, one may forget the name of a disliked person as an unconscious method of insulting him.

The mechanism of forgetting is often used when motives conflict. It is one of the easiest ways to settle conflicts, by completely excluding from the mind one of the opposing trends. Sometimes this occurs *en masse;* anything and everything that springs from the social impulse or from the sex impulse (seldom the ego impulse) is repressed beneath the level of awareness. Invariably this causes trouble, because these impulses still strive for fulfillment, and the emotions from them reverberate through life, causing unaccountable distress.

"Forget it" is not always good advice, but as commonly used the phrase means "don't brood over it"—and that is certainly in accord with mental hygiene.

Projection. Projection consists of externalizing or projecting one's faults and failures upon something or somebody else, and blaming them for it instead of admitting one's fault and blaming one's self. In popular parlance this is known as "passing the buck" or making an "alibi" for one's self. This is a mechanism that never does anything but harm to mental health, and should never be used under any circumstances.

Parents often innocently cultivate this tendency in young children. For example, if a child falls down and bumps its knees the mother may say "naughty sidewalk," in order not to let the child have any feeling of self-blame for awkwardness. The same child at an older age, if he plays a poor set of tennis, may throw away his racket in disgust, not at it or at others, as he thinks, but, unconsciously, at himself; or if he is not pleased with his part in an interview he bangs the doors as he goes out, unconsciously exhibiting the disgust with himself that he will not admit. If he faced his own shortcomings, tennis rackets and doors would not have to stand in his place to take the brunt of emphatic disapproval.

Sometimes it is a situation that is blamed—poverty, lack of education, lack of "pull," disasters of one sort or another, or "the times." Of course faulty situations often do partly account for individual shortcomings, but they should bear their own part of the blame, not the part that belongs on the individual.

Most often it is other persons upon whom one's errors of omission

or commission are projected. To do this serves several purposes. First, it rids one of shame or blame that would be intolerable if admitted. For example, failure at a given task is humiliating if admitted; therefore not many people, even in this supposedly frank generation, will frankly admit it to themselves when they fail. It is more comfortable to think somebody else is to blame, and this they unconsciously persuade themselves is the case. One who flunks a college course, for example, may, by the mechanism of projection, assure himself that the instructor was incompetent, not himself.

Second, it gives him a chance to despise somebody else as he would have to despise himself if he admitted his fault. Third, it makes him feel not only blameless but positively virtuous if he can show how much he detests that particular fault. For example, a person who constantly interrupts others in conversation, may accuse everybody of interrupting him, and say that if there is anything he cannot stand it is people who interrupt. Those who are the most suspicious of immorality of various kinds in others may themselves be strongly tempted, if not actually at fault, in the same ways. Those whom we criticize and censure most violently may be those who represent ourselves at our worst. For example, a dishonest person finds dishonesty all around him: he says "You can't trust anybody," or if he does not say it he may show that he feels it.

Projection becomes a serious matter when a person begins to believe not only that others are to blame for his difficulties and failures, but that they are deliberately standing in his way, maliciously opposing him and trying to harm him. This is known as a paranoid trend, and it may lead directly to a mental disease known as paranoia. Those who are inclined to think that others "have it in for them" or are inclined to feel abused, should realize that they are comforting themselves by using one of the most insidiously dangerous of mental mechanisms. They should receive professional help in overcoming it, if they cannot overcome it themselves.

Escape into Phantasy. When the real world is unpleasant, a person may flee to a dream world, and take up his abode in castles in the air. His dream land is peopled with individuals not at all like those he knows, but always kind, considerate, appreciative. Life is luxurious, easy, satisfying. He himself is not like his real self, but is gifted, noble, successful, admired. Time may change from the present to the past or the future; the scene may shift from the familiar to that which is wholly imaginary; people may be real people idealized or perfect creatures such as are born

only of dreams. Since all his wishes come true, the one who departs thus from reality is happy, no matter how at variance his dreams are from the facts. "I dreamt I dwelt in marble halls" is to him more satisfactory than troublesome contact with realities that seem to him tawdry and depressing, or that demand too much of him.

Phantasy often takes the form of a perpetual series of temporary identifications with heroes of books, plays, and moving pictures, or even with those who figure in the newspapers. Some people live their lives almost entirely vicariously in the lives of others, and find it a satisfactory substitute for personal experience and personal joy in life. Rather than live their own lives, they prefer to identify themselves with those who do what they themselves would like to do if they had courage enough, or if they felt powerful enough, or charming enough, or if their conscience would consent, for it may be the villain rather than the hero with whom identification takes place.

Fancy often plays havoc with life. It does so when it makes one discontented with the real, and when it proves so satisfying that it paralyzes efforts to gain satisfaction through the real. In the extreme it produces individuals who are entirely out of touch with the real and who become thoroughly deluded. In lesser degrees it produces: "shut-in" personalities, whose joys come chiefly through inner contemplation, and to whom the world of events is of little significance; or "daydreamers," who drift on clouds and cannot come down to earth long enough to concentrate on any of their own problems; or "planners," who create situations within their own minds which they scarcely even try to materialize—buy books they never read, enroll in courses they never take, block out stories they never write, etc.; or drug addicts and alcoholics, whose artificial aids to phantasy constitute an additional danger.

The use of the imagination as a protective mechanism is not to be confused with its two other uses. The power to imagine is one of man's greatest endowments. It is the fountain of art and of scientific discovery; but creative work comes from those who harness their imaginations to reality, taking short flights away from it, and returning to it, bearing gifts.

Almost of equal importance for the average person is the use of the imagination to give color to life, and to relax the tension of combat with the real. It gives the "light touch" that may be more effective than ponderous blows. Furthermore, it aids in obtaining perspective upon one's problems, and an objective attitude.

Imagination may indeed be an aid to a better life, if it is kept in

contact with the real world. It is a deadening substitute for life if it feeds entirely on itself.

Identification; Good or Bad? This mechanism consists of establishing a sense of oneness with another. It begins early in life as identification of children with parents. Later, other heroes and heroines are chosen. When complete, it causes a person to feel as if he were the other and to share what the other feels. Sometimes it also includes emulation, or molding one's self after the other as a model. This mechanism is one that leads on the one hand to the highest traits of human beings, and on the other hand to some of the worst.

In everyday life, identification often occurs in the form of hero worship. This may or may not be desirable. If the spirit of emulation is aroused, and the model is a good one, it is likely to be a constructive element in one's life. But the choice of a model is often made quite unconsciously, and on grounds other than that the model is one deserving of imitation. For example, a person may be so fully identified with a parent that the very weaknesses of the parent are unconsciously reproduced (e.g., the mother's timidity, or the father's fiery temper). Not only the wish behind identification, but even the fact of identification may be unsuspected. For example, many women who dress "out of character" have no idea that they feel akin to those they copy or that any manner of life other than their own appeals to them.

Identification may be destructive rather than constructive when it is so complete as to cause a person actually to feel as if he himself were what the hero is and had accomplished what the hero has, and consequently to cease to be much interested in his real life or to make efforts on his own behalf. This type of identification usually is made by those who wish to feel great but wish to avoid the hard work of becoming heroes themselves. In extreme cases, a person may even be unable to differentiate his own personality from that of the hero, and may believe incontrovertibly that he is, for example, Julius Caesar, Napoleon, or Henry Ford. This is known as delusion.

At its best, identification is responsible for the feeling of empathy, or the ability to comprehend in other people even that which is foreign to our own make-up; and sympathy, or the tendency to be drawn toward others whom we unconsciously feel to be like ourselves or to have problems like our own. Identification may well be considered the root of altruism. Those who see all other people as other selves and are guided by that concept, can hardly fail to live generous, socially useful

lives. This mechanism is tacitly recommended in the Golden Rule, "Do unto others as you would they should do unto you."

Conversion. This term implies the gratification of a wish through physical illness. A person who is ill cannot be expected to do the same things that a well person does; he can excuse himself for many acts left unperformed and can expect others to excuse him. Instead of blame, he may even receive sympathy and signs of affection. Therefore, it is not surprising that illnesses sometimes represent wish fulfillment. Headaches, indigestion, this and that symptom, may feel like the real thing, but be of psychic origin, not physical. In such cases they often are rooted in an unconscious wish to make impossible that which one finds disagreeable.

This mechanism is often at the root of the psychogenic illnesses mentioned in the previous chapter, and usually is based upon an essentially neurotic type of personality. It becomes especially "useful" when there are extremely distressing circumstances to be evaded. As noted, battle conditions and military life in general, may present more problems than a person of limited adaptive power can face and solve. Therefore, the mechanism of conversion often comes into play to bring safety at the price of psychogenic sickness. Even blindness or paralysis may occur on such a basis.

Some people gratify their wishes through ill health throughout their lifetime. The wish may be to gain the tender protective attention such as parents lavish on a sick child, or to have an effortless life, or to punish the ones who are inconvenienced by the illness, or to account for one's failures—any of a number of wishes. These illnesses are not imagined. Those who are so afflicted bring their troubles on themselves, but not voluntarily; and they cannot be cured of them by will power—only by finding better solutions for their conflicts. The services of a psychiatrist are almost always needed in such cases.

Emotionalism. As a mental mechanism, emotionalism implies either luxuriating in emotions for self-gratification or displaying emotions to appeal to others.

Since it is only by means of emotions that motives become acted upon, mankind has acquired respect for strong emotions—the lofty emotions such as reverence and patriotism that make a person true to his God and his country, the kindly emotions of love and pity that make him true to his fellow beings, and the stern emotions such as righteous indignation that sends the peace-loving into war against wrong.

It is a source of satisfaction to feel that one is capable of great emotion,

but there is danger that one will stop at that point, satisfied that one has reacted suitably to a situation when one has felt deeply about it. Many of those who are, for example, "moved by compassion," withhold their compassion from expression in any acts of kindness, but wallow in softheartedness. If they do take action at all it will be along lines that intensify their feelings still more (e.g., indiscriminate alms, which is for the sake of the giver, not the receiver).

As for outward expression of emotion, a limited expression is natural. It is instinctive to draw the muscles of the face upward in a smile when pleased, and downward when displeased. Early in life the child learns that the response of his associates is colored by the emotions he shows, and that he can often win the responses he wishes by either allowing his genuine emotions full play or by simulating emotions he does not feel. With many adults, this device is used either deliberately or unconsciously to gain respect, sympathy, or attention, or to force compliance to their will. Often, emotional display undoubtedly is not at all purposeful, but merely evidence of immaturity of personality or of lack of good breeding.

We have coined the verb *to emote,* which means to be emotional or exhibit emotion in unsuitable ways and degrees. "Emoting" is usually, if not always, evidence of weakness of personality. On the other hand, unfortunate as is the habit of emoting, it is perhaps even more unfortunate for one's mental health to feel too little emotion on significant matters, or to show too little.

Reaction Formation. This term means going to the opposite extreme in expressing an unconscious wish. For example, a person who is inherently cruel may develop instead an exaggeration of gentleness; one who is inherently selfish may be known as the most generous of mortals; one who feels antagonism to another may go out of his way to show an excess of devotion; one who has an undue interest in sex may react against it in disgust.

Although this mechanism is largely an unconscious one, it often leads to very desirable social results (e.g., charity, chastity, good manners, etc.). Nevertheless, it is better to be aware of one's real tendencies if possible, and to place one's behavior on a conscious basis, for reaction formation is likely to fail at times and the repressed wish to appear at the surface (e.g., outbursts of cruelty in the overgentle).

Substitution. When a much desired goal seems impossible (either hopeless or wrong), another may be set up in its place as a substitute. In college it is often thought that the "grind" is using this mechanism,

substituting intellectual achievement for the social success he cannot win. Probably the opposite is just as often the case. In any case of substitution, rationalization also is likely to occur, to make the rejected goal seem inferior to the substituted one.

Substitution may be effective in helping a person to dispense with what is primarily desired and may give a satisfactory state of mind and a useful adaptation to life, provided the second goal is an important one, and is pursued with interest and energy; otherwise not. For example, women may substitute commonplace activities such as puttering over clothes for the ideal of romance and motherhood; but they are still likely to feel thwarted. Or they may substitute a significant sort of work (such as a business career) but not put enough interest and energy into it to gain full satisfaction from it or to prevent their ungratified wishes from rankling.

Symbolization. Symbolization consists of setting up a second goal that not only substitutes for the first, but also symbolizes it. This sometimes brings a satisfactory adjustment; sometimes not. For example, in the case of a woman who gains euphoria through bringing up other people's children if she has none of her own, symbolization would be of definite personal and societal value, especially if she prepared herself adequately for her career (e.g., teaching). On the other hand, if pets instead of children were substituted as the object of her maternal impulses, she herself might gain as great euphoria, but society might be harmed to the extent that it was deprived of her services in more constructive ways.

Civilization has been greatly aided by man's faculty for symbolizing, especially for using words as symbols. Yet with any symbol, there is the danger that it will supplant the reality it represents. For example, saying that one believes in democracy may become a falsely satisfying substitute for actually being democratic. Similarly, those whose emotions respond readily to the symbol of the flag or the cross, may have little practical patriotism or religion and those who are eager for marks may be quite indifferent to any educational achievement for its own sake.

Sublimation. As the term implies (sublime; lofty), sublimation involves setting up a substitute goal higher in the cultural and the social scale.

There can be no question that some goals are, by any reckoning, higher than others. For example, the work of a newspaper reporter is certainly on a higher level than that of the "village gossip," both being activated to spread the news.

Some goals are not, however, intrinsically higher than others, but become higher for some persons at some times and in some circumstances. For example, one who is barred temporarily from mating and parenthood is in those circumstances acting on a higher cultural level if he pursues the goals of personal achievement and of nonmating friendships and kindly service to his fellow men instead of sex goals.

Sublimation is always a valuable mechanism. Often it occurs unconsciously and is responsible for fine personalities that appear to "just grow."

In a good many cases the choice of a profession is unconsciously made through the mechanism of sublimation. For example, that aspect of instinct which shows itself as "natural curiosity" may be sublimated so as to produce the research worker in science; or the crude impulse to be conspicuous among one's fellows may be sublimated so as to lay the foundation of great leadership.

Since the desirable mechanism of sublimation does not always take place of its own accord, it is important that this sort of adaptation be engineered. It may not be necessary to deny any of one's natural interests, but simply to set them to work in a way that is truly representative of one's best self, that utilizes one's best powers in the best ways—the term best in each case meaning most adaptive. Often it does not involve any change in a present occupation, but merely a new attitude toward it. The teacher, for example, has an occupation that might be, and often is, looked upon merely as drudgery to earn a living, but it may also be looked upon as a valuable opportunity for the most complete sort of self-realization in a social field of the utmost importance. Nearly all occupations may similarly be given greater significance (i.e., be used as a means of sublimation), and thereby be a source of greater satisfaction and sounder mental health.

Self-direction of Impulses

There is an advantage in having impulses that lead in the general direction of self-preservation, social solidarity and race preservation, and there is an advantage in having automatic, conflict-solving mechanisms, but there is an element of danger in the situation, as has been shown.

The inevitable conclusion is that for most people the impulses must have a good bit of direction. And man fortunately is equipped with a cerebral cortex able to undertake it.

Is Self-analysis Possible? Analysis means resolving a compound into

its component parts. Logically, this is the first step in any attempt to change the compound for the better. In reference to personality, analysis means finding out what factors make it what it is—what impulses are being thwarted or being gratified in unsuitable ways, what impulses are in conflict with others, and, too, what impulses are being gratified in suitable ways. Also, it means finding out what mechanisms are in common use. In other words, it means finding out both the weaknesses and the strengths of the personality, and its habitual reactions.

It is not always possible for an individual to make a very thorough analysis of himself because the mechanisms of forgetting, projection and rationalization tend to keep him from seeing himself as he really is. Nevertheless, with a determination to be utterly frank, it is often possible to take an objective attitude toward one's behavior and to put one's finger at once on some of one's favored methods of wish fulfillment. This is especially true if one starts with the assumption that one is not peculiar but more or less like everybody else, with the same general aims and the same available methods for reaching them.

Synthesis: Its Accomplishment. Analysis of personality requires subsequent synthesis, or reassembling the forces of the personality for more adaptive purposes. In many cases, synthesis may begin without any preceding analysis, the principle being that responses that were formerly satisfying are likely to be automatically abandoned when replaced by responses that give still greater satisfaction. For many individuals, the method of choice for improvement of personality is to begin assembling a set of suitable reactions intended to supplant any unsuitable ones to which they may be addicted. Utilization of their "wish power" in voluntarily sublimated ways is the chief need for the vast majority of the 80 per cent who have not the maximum of mental health. Some of the possibilities of gratifying wishes at a high cultural level will be mentioned in reference to the specific wishes.

The Role of Will Power. Will power may be defined as the intellectual faculty of keeping a wish in focus. The method consists of thinking hard about the real wish and the real benefits of having it granted. If the wish is strong enough and clear enough, no great amount of will power will be necessary to keep the wish in view, even when its gratification must be postponed to the remote future (e.g., in studying for a profession).

The use of will power becomes important when a wish is not very strong or is in conflict with another wish of equal strength. In such circumstances, after a suitable choice has been made among one's wishes

and the modes of granting them, the will should be used to full capacity to intensify a wish which one has decided should be gratified in a given way.

The Use of Suggestion. Most human beings are suggestible, or subject to a tendency to think or feel or act as something or somebody suggests. Everyone has a chance to observe this tendency in himself from time to time. For example, if one is told emphatically and repeatedly that he wants a given thing, soon he begins to want it badly. Advertisers use human suggestibility to the great advantage of producers and the great cost of consumers.

One sort of suggestion—that which is made to one's self by one's self—is known as autosuggestion. It consists of trying to implant in one's mind the conviction that something not so is so or will be so. Fake psychologists have given much publicity to this method of self-improvement, and have made it popular because it sounds as though it would work and seems easy and harmless to try. They say "Think success and you will win it"; "Hold the thought of health and you will be well."

Autosuggestion sometimes works, but it is a dangerous method to use indiscriminately. In many cases it amounts to turning away from the facts and diverting attention from far more practical steps that need to be taken toward one's goal. The only safe use of autosuggestion is to suggest what is true—and not only true but constructive. For example, many a person who continually says to himself "I am a failure" is not really a failure, having failed in only a few tasks, and is hindered rather than helped by centering his attention on his failures. He would do better to remind himself of his abilities and the ways of using them.

If outside help is needed in redirecting personality trends, it should come from those who by profession understand the human mind, or from those who have themselves attained mental health through a rich experience with life. Usually there is little for young people to gain through attempting to "psych" each other.

Psychiatrists use analytical methods. Some use a special technic (psychoanalysis) for revealing difficulties hidden in the unconscious mind, a process requiring months or even years. The majority of psychiatrists and psychologists find that difficulties often respond to much less deep probing.

The numerous quacks in this field, giving expensive courses of lectures on "Charm" or "Success" and the like, publishing books on the subject, and maintaining offices as "Psychologists" or "Psychoanalysts" do harm

chiefly by taking money for nothing, although in some cases their incompetent advice has brought very bad results. It should not be difficult to distinguish between professionally trained persons and fakes. The former make no glittering promises, do not advertise, are not mercenary, and have a verifiable record of education and experience.

16
The Self Impulse

The "I" and Its Demands

Starting with consideration of the positive and negative tropisms of the most minute creatures, and concluding with consideration of the behavior of modern man, one inevitably concludes that the individual organism is driven from within toward many different acts of a self-seeking nature.

The primitive self desires to keep itself alive and safe and comfortable, and this desire extends through the entire realm of living things. At the level of man, the being is not simply a body to be nourished, protected and made comfortable, but a body containing a mind, an "I," desiring to keep its psychic selfhood intact and to protect and gratify its personality.

What Is the "I"? Freud uses the terms id, ego and superego to indicate the three levels at which self impulses arise. The id (Latin word for *it*) is the undifferentiated self at the purely instinctive or impulsive level. The ego is the self at the level of everyday living, as modified by contact with the world and people; its impulses are the same as those of the id, but they are modified (either increased or diminished or changed in their direction) as a result of experience. The superego is a higher self, which is the product of identification with those that are respected and the ideals they represent.

In order to avoid making this section unduly complicated, the term ego will be used to refer to the self in all its aspects, although it is to be understood that the ego motives to be mentioned include on the one hand the demands of the "natural" or undeveloped self, and on the other hand, the demands of the higher or ideal self.

Demands of the Ego. One strong urge is at the root of man's being,

the urge for self-esteem. Man wants much for himself in life. But whatever he gains in the way of physical, intellectual, and esthetic satisfactions, he cannot be content unless he takes pride in himself. This desire is tied closely to all other desires and it influences the way in which they are carried out. It carries with it enormous motivating power and can even become strong enough to triumph over every other demand of the personality, even the demand for life itself. Countless individuals have died rather than surrender an iota of their self-respect.

In everyday life the wish to feel superior is in constant operation, determining small acts and large, often quite unsuspectedly. Mental health depends to an important degree upon the ways in which this impulse is acted upon. It must be gratified in suitable ways, or the personality may completely disintegrate.

The psychobiologic origin of the urge for a feeling of self-esteem is initial feelings of inferiority.

Inferiority and Superiority

Inferiority Feelings. Everyone is born a weak and feeble infant, undoubtedly from the day of birth feeling inferior—insecure, helpless, unimportant. Experience in early life may increase this feeling, as the infant and child compares himself with others, and through his own observations and the judgments of others, acquires a sense of ignorance, shame, guilt, and the like.

With normal development, reassuring experiences occur which partly counteract these dysphoric feelings of inferiority. But they can never be entirely banished, for no one ever attains perfection. Only the feebleminded who cannot form adequate standards, and the psychotic with delusions of grandeur, will not at times feel more or less dissatisfied with themselves.

Dissatisfaction with the self may be looked upon, in the words of Browning, as the "spark that disturbs our clod," bestirring toward the euphoria of feeling superior.

Several points should be noted about feelings of inferiority. First, they may be valid, based upon actual inferiority of some degree (e.g., a physical defect, or a recognized lack of certain abilities). Second, when valid they may be in proportion to the facts or quite out of proportion to them in either direction—either disproportionately great or little.

Third, they may be fictitious, with nothing real to warrant them. Their cause may be early experiences in which one felt neglected or humili-

ated. The feeling may have been well-founded when it arose, but may continue long after the reason for it has ceased; or it may have arisen from misconceptions. For example, many a child feels falsely humiliated by family poverty.

Fourth, feelings of inferiority may not be felt as such. One may not be aware of them specifically, but only of an unspecific unrest, and an equally unspecific urge toward a more comfortable state of affairs. Many a person whose whole life is a response to the feeling of inferiority has no idea what is motivating him. This is likely to be the case particularly when the underlying feeling of inferiority is so intense and painful that it is involuntarily excluded from awareness.

Developing a Sense of Superiority. The infant first obtains the feeling of superiority through some actual superiority—some experience such as success in balancing its bottle so as to drain all the milk from it, or retrieving its rattle from the edge of the crib, or the numerous experiences with its relatives that convince it of its importance. Thus do those born helpless and weak gradually acquire a good opinion of themselves.

Like their opposite, feelings of superiority may be valid, based upon actual superiority, in which case they may or may not be in proportion to the facts; or they may be fictitious, in which case they may be due to misleading situations early in life (e.g., pampering by parents; or a single success showered with great praise; or superiority in one respect, such as appearance or muscular prowess, which aroused so much comment that it led the child naively to believe itself superior in all respects), or to mistaken methods of becoming pleased with one's self.

Experience in living gives specificity to the desire for self-esteem. Having experienced dysphoria from a number of sorts of inferiority, man correspondingly craves euphoria from a number of sorts of superiority.

By adult life, if not before, all persons are driven to obtain the feeling that they are not unworthy, but virtuous; not foolish, but reasonable; not ignorant, but wise; not bound, but free; not weak, but powerful; not incompetent, but able; not insignificant, but important.

Each of these wishes, and several others, may be called maximation motives, because they urge the individual toward the maximum of self-aggrandisement. In less technical language, they may be called "superman" motives, or simply superiority motives.

As has been indicated, it is the feeling of self-esteem that the self craves. This feeling may be obtained through reality or fiction.

With normal development of the powers of observation, it soon be-

comes clear that feeling superior is the logical result of being superior. As a result of this observation, primitive man, phylogenetically and ontogenetically, is impelled by the reality principle toward actually becoming superior. By acting upon this principle, the race has attained, and its individual members can attain, all that is comprised in the term civilization.

Because the acquiring of real superiority is often a long process, involving effort and some discomfort, and because it is a simple matter merely to feel as if one were superior, the principle of fiction governs many a response to the urge for self-esteem. There are innumerable ways to bolster one's self-esteem without having done anything at all to become estimable.

Obviously, "soft" personalities will make use of short cuts to euphoria regarding themselves, even when they know they are short cuts and give only fictitious euphoria. And therein lies a serious hazard to mental health and happiness.

Specific Ego Motives

Undeniably, many people want scarcely more in life than physical comfort and ease, sensuous pleasures, and amusement, a "good time." Yet certain other wishes activate all persons to some degree and in one way or another. Ten of the most important of these will be considered here. It should be noted that each may tend toward fine living or failure according as it becomes directed along good channels or poor.

To Feel Virtuous

All persons wish to feel that what they do is right. All have some sort of code they try to follow. But all fail at times and must do something to rid themselves of the feeling of guilt.

Ethical standards are so ingrained that most adults would be uncomfortable or even profoundly distressed if they had to admit doing anything wrong according to their code. Therefore, they convince themselves that whatever they do is still according to their principles. They may tinker with their code, and make it elastic enough to permit what they know it does not permit, or they may adhere to the strictest interpretation of the code—the "letter of the law"—and yet somehow succeed in making their faulty behavior fit into it.

The mechanism of projection may be used in several ways to defend

one's self against a feeling of guilt. First, a person may convince himself that someone else is in the wrong, not he. Second, if a person has a given fault and cannot bear to admit it even to himself, he may condemn it strongly whenever he sees the same fault in another person. He has taken his stand against it, and feels that he could not possibly be guilty of a fault he so abhors. Third, he may use the *tu quoque* (you also) mechanism, relieving his own feelings by convincing himself that others are just as bad.

Rationalizing is a favorite mechanism for justification of wrongdoing. The man who steals, for example, must feel that he was right in doing so, or his punishment at the hands of his own personality would be more severe than his punishment by the courts. He therefore clears himself in his own mind by some such rationalization as that the world owes him a living, or that rich men are fair prey, or that the one from whom he steals has no more right than he has to the thing stolen.

One of the dangers of not being willing to admit that one is wrong is that one may lower his code to fit his behavior. Indeed, one of the favorite rationalizations is that ethical codes are impossibly high; "I'm only human," a person says. Another is that the codes are old-fashioned, "outmoded"—no doubt all right for people of olden times, but not for "moderns." A corollary of this rationalization is association only with persons who hold the same standards, with whom one can always feel right.

There are those who do not readily rid themselves of a sense of guilt but, instead, become oppressed by it constantly. In such, the sense of guilt is often fictitious, aroused perhaps in the first place by self-blame for a minor error they were led to believe was a heinous offense (e.g., the phantasy type of lies that children tell, or the sex play of childhood).

It is natural to feel guilty at times, for no one is perfect; but it is unnatural to feel so all the time. If such a mood prevails, it is usually not valid, and it would be well to discuss it with one's religious adviser.

To Feel Reasonable

One of man's favorite conceits is that he is above all else a reasoning, thinking being, and that all his opinions are logical and all his behavior sensible. He likes to feel that his judgment controls him, not his emotions.

How to Be Sure One's Opinions Are Sound. Whatever opinions a man holds, even though they be merely hand-me-downs from his vari-

ous "bellwethers," he defends them as if they were the product of his own painstaking search for the truth.

Opinions are held on many subjects by those who are not entitled to them. The only ground for an opinion on a given matter is sufficient knowledge concerning it. Yet the average individual holds, or can produce, emotionally determined opinions on almost any subject that is presented to him. He "knows" this and that because it would not be emotionally comfortable for him to know anything else.

It would disturb him, for example, to find any flaw in the opinions acquired early in life; it would reflect upon his wisdom in the past if he should change his mind. It might "unsettle" him if he ran the risk of acquiring new opinions. Furthermore, the mere acquiring of sound opinions would cause him a great deal of work; it is easier for him to be sure he already knows. Finally, it would be embarrassing to him to admit that there is anything about which he has formed no opinion.

Seneca said, "Many men had been without question wise, had they not had an opinion that they had attained to perfection of knowledge already, even before they had gone half way."

The prejudiced often confirm their belief that their opinions are sound by going through the motions of listening to new evidence. It is often part of their rationalization to consider themselves open-minded. Also, to complete their feeling of rightness, they must be sure that those who hold opposite opinions are wrong. In fact, the tendency to attack the intelligence, even the good faith, of an opponent, often betrays the "biased" partisan. Those who reason have as deep feelings as those who rationalize, but they are not aroused to the same type of fiery defense of themselves or intolerant offense against others.

How to Be Sure One's Behavior Is Reasonable. Man likes to believe that his behavior is always wise, never foolish—always the product of sound reasoning, never the product of emotions. Yet very often man is swayed by his feelings contrary to his judgment. In such a case he is likely to search out a comfortable argument to convince himself that what he has done or plans to do is really very sensible. For example, a person who has been given a weight-reducing diet and fails to follow it, argues to himself that the doctor did not "guess right" about what would cause him to lose weight, or that breaking the diet once in a while would not make any difference, or that he could not embarrass his hostess by refusing food served him, and so on.

Of course, it is too much to expect that everyone should always be

reasonable; in fact, there is room for emotionally determined behavior that accords with the total personality. The difficulty is that acts done only because one feels like doing them, often amount to folly, and that rationalization is so very extensively used to justify such folly.

To Feel Wise

How to Avoid Feeling Ignorant. The normal child begins to show curiosity about his environment and himself while still very young. His first conversation is chiefly "Why?" and "What?" and "How?" Clearly, man possesses a native trend to ask questions and demand answers, and to feel pleased with himself when he knows the answers.

The thirst for knowledge is not always clearly apparent in "students," however. Its abatement may occur because other interests arise, overshadowing it; or, more often, because the individual has not the kind of mind that is a joy to use and never does experience the euphoria of making knowledge his own.

There remains in all persons, nevertheless, a desire to feel as if one were a knowing person, and if this feeling cannot be, or is not, obtained through learning, substitutes often satisfy. Some become dilettantes, dabbling here and there and never really knowing anything, but satisfied that their smattering of knowledge is the real thing. Some set up marks and diplomas as symbols, pursue them by the easiest route, and are content for the rest of their lives if by hook or crook they are able to achieve the symbolized goal. Some keep themselves satisfied with their superior learning by associating only with those who know less, which makes them shine by contrast; or by associating, if possible, with those who know more, which causes them to shine in reflected light. At nearly its lowest level, the knowledge motive is satisfied through inquisitiveness—as the Paul Pry type, the readers of society, or movie gossip columns, and the like.

Normally, a person does not enjoy the feeling of being a knowing person unless he has real knowledge—at the minimum, enough to keep himself alive and well and able to fill a useful role in life. At the highest level, Truth itself is the goal, and an open mind and the fullest use of the brain is the method.

To Feel Free

One of the surest ways to arouse a response in a young infant is to restrain its freedom of motion, as by holding its hands or feet. At any

time in life, the feeling that one is not a free agent is abhorrent to man. Even a miser would rather pay a heavy fine than be put into prison, and this not solely because of the social stigma.

At its best, the freedom motive has served man well. It has been at the root of much progress in civilization along political, social and economic lines, and has spurred many an individual to rid himself of unnecessary shackles; but also it has been responsible for lawlessness and anarchy in small and large ways.

Those who show the rebel spirit, who defy regulations, seek freedom (with a capital F) often do so because they feel bound and helpless within, and strive vigorously to shatter the bonds of their weakness. It reassures them every time they can make it plain in word or deed that they have liberty, can manage themselves, do not need guidance by law or statute, or by any dicta of authority. Not only do they break laws and customs, but they often feel that these are unnecessary trammels upon civilized people, and would establish, if they could, a state of anarchy—all because they feel bound and want to feel free.

From the desire to feel free comes a negativistic attitude commonly known as contrariness. The individual cannot bear to feel he is not free to make his own decisions and act as he wishes. He is constantly on guard lest anyone dictate to him or try to manage or influence him. He may even resent the mildest of suggestions, and call them "nagging." If he is advised to do one thing he may feel impelled to do the opposite in order to feel that he is independent. Usually, he takes great pride in this trait, considering it evidence of his strength of personality.

Such a person is in a bad way regarding a career, for he finds himself unable to work under anyone else's direction, to say nothing of taking orders. A time clock, or even regular hours and regular duties, make him feel like a slave in chains. Even a partnership may be galling to him. If he cannot be "in business for himself" he often goes from one position to another, leaving each because he will not "let himself be kicked around" by a boss who is too bossy—and to him they all are.

In circumstances that oblige him to take orders (as in the Army) such an individual must either change this personality trait quickly or have it changed for him by perhaps bitter experience.

In those who develop normally, it is soon apparent that personal freedom can never be complete. One is inevitably restrained by circumstances, by social standards, and by one's own limitations. One normally

accepts the inevitable, and also comes to see that it is often safer and wiser actually to place one's self voluntarily under certain sorts of restraint. Indeed, it appears that the only freedom we have is, within limits, to choose the kind of restraint we prefer.

To Feel Dominant

Obtaining Self-mastery. Man does not like to feel helpless in his own hands. He wishes to feel that he can make himself do what he chooses. He is prone to rationalize that everything he does is because he chooses to do it, and everything he does not do is because he chooses not to do it. For example, nearly everyone who smokes too much says, and makes himself believe, "I could stop if I really wanted to." But often the effort is not made, lest he learn that self-mastery is not complete.

When the desire for a feeling of power over one's self leads to the actual development of such power, the result is the type of personality justifiably known as "strong." When it leads to nothing but rationalizations, the personality is known as weak or soft—two adjectives often applied to recent generations to contrast them with hardier generations of the past in whom self-mastery was no more necessary but undoubtedly more often valued and sought.

The person who really has himself well in hand has plenty of chances for euphoria in his everyday life. For example, he will take pride in making himself get up on time, keep his appointments promptly, stick to his work, and take enough exercise and sleep. And when real difficulties arise he will obtain compensations the weak person does not. Afflictions will not be purely afflictions to him; they will be, from one angle, a source of euphoria. He will take pride in his self-mastery when there are hardships to be endured without complaint; pain to be borne without flinching; temptation that must be resisted; pleasures that must be denied; great efforts that must be made. In other words, he "can take it," and make something of it that fills him with glory.

Power over Others: Useful or Abusive? The world needs many sorts of rulers, directors, and leaders, and the native impulse to rule ensures a full supply. It also supplies rulers where none are needed.

Even when they have no real authority, many people cannot resist taking advantage of situations to do as much managing as possible. Nagging by husbands and wives is notorious, and those who actually do have authority often use their position to intensify the feeling that they can make others do their will. Parents and teachers may overguide their

children; executives may become martinets; team captains may become "bullies," and so may traffic officers; politicians may become "bosses" or even dictators.

A particularly intense desire to subjugate others is likely to be aroused especially in those who have themselves been browbeaten. To compensate for their still painful humiliation, they seek to humble others. Often they actually seek out situations or enter careers giving them control over others, and then require that others bow down to them and cringe under the lash of their tyranny.

Scarcely any dictator, big or little, could like himself if he admitted that he was imposing upon those who could not help themselves; but none admit it. Instead, they may rationalize that their domination is "for the good" of their victims.

Those who sublimate the desire to rule cannot be satisfied with any but clear objective evidence that they are fit to rule, and that their rule is wise and kind. From such sublimation come the leaders whom others gladly follow.

To Feel Adventurous

The Challenge in Adventure. To fare forth where danger but ultimate joy and glory may lie is an inborn trend. Primitive man would never have left his cave dwelling had he not been challenged by the new and untried—had he never asked "I wonder what would happen if. . . ." and had never answered "I will try and see."

The adventure motive is as important to modern man as to the fabled heroes who climbed to the top of beanstalks and went to sea in pea-green boats. What he desires is to feel that he is not the sort of person who can get along only in an easy and comfortable existence, but that he could meet any situation in which he might find himself. To convince himself, he may merely indulge in phantasy, obtaining the feeling of daring by dreaming of himself in daring roles. Or he may identify himself with the daring by reading stories of adventure or listening to the accounts of those whose business is danger. Many create for themselves actual situations that give scope for their enterprising spirit, and gain a valid euphoria therefrom.

When unbridled, the adventure motive leads to sheer rashness. It produces people of the daredevil type whose motto is "Try anything once." On the highways are many whose fast driving represents a mental mechanism to convince themselves of their bold intrepidity. Obviously,

their euphoria from such sources is likely to be brief, and so, also, are their very lives.

In some, exaggeration of the adventure motive leads merely to a pressing need for change and excitement. It produces those who are unstable at work, tiring of a job as soon as the "new wears off." Such a person is a good starter but a poor finisher, beginning each task with enthusiasm and perhaps with ability, but dropping it soon in boredom. Real hoboes belong to this class, and so also do the less commonly recognized business and professional hoboes, who wander from one situation to another, and whose interests do not "stay put." Fickle friends often belong to this class—those who are "off with the old love and on with the new" in a perpetual succession, their capacity for friendship having breadth but not depth.

When sublimated, the wish to feel daring in adventure may lead a person to take up a career in which something new, exciting and significant is always happening—for example, pioneering in the early days in this country, or braving today's frontiers, somewhat different from those of old, but still frontiers calling for pioneers. Many sorts of scientific research give scope for the adventure motive. So also does the practice of certain professions—for example, the practice of medicine, especially surgery.

It is not necessary, however, to lack legitimate gratification of the adventure motive, whatever the career, for everyday life may be made an adventure. It may even be an adventure to try to "make both ends meet." The characteristics of those who have sublimated the adventure motive are initiative and enterprise in promising conditions.

To Feel Victorious

The fighting reaction is just as natural to man as to animals. It is aroused by actual attack by a foe, or by threat of attack. In everyday life it is often aroused by the feeling of being imposed upon or insulted, or by the presence of obstacles to achievement.

Most people like to "come to grips" with reality of some sorts at least. Yet some never derive euphoria through any sort of combat. Either they prefer the safety of flight, or they like the martyr feeling of being victimized, or they have always taken everything lying down and do not know the thrill of a fight—a thrill separate from that of victory, as every athlete knows.

The fighting tendency may become a dominant trait. Sometimes it is

exhibited in petty ways. Some people are never so happy as in a "row," and even pick fights unprovoked; especially those who have an inward sense of weakness are likely to adopt a belligerent attitude. So also are those especially gifted with verbal fisticuffs; they miss few opportunities for worsting their associates in an argument.

Normally, the fighting impulse is restrained from crude expression by discretion or the amenities, and is symbolized, automatically or deliberately, by combat in sports, or by competition in work, or by struggle against difficult situations, or by "fighting the good fight" against the wrong in one's self and the world.

To Feel Able

Attaining Euphoria. It is the desire to feel able that impels man toward the use of his powers to accomplish something he can be proud of. In early life, this wish is satisfied in simple ways. When a baby first climbs the stairs he may repeat the performance until exhausted, his crows of glee plainly saying, "I *did* it."

Later in life, the quality of the performance becomes of importance. The adult does not take the same pride as the child in merely strumming on the piano, but only in musically acceptable playing. The more adult an automobile driver, the more pride he takes in weaving his way in and out of traffic without bumping or being bumped. Whatever one does, one takes pride in the skill with which it is done. One likes to say "I did it *well*."

As the achievement motive becomes sublimated, the thing done becomes significant—it must meet social approval; one must be able to say "I did *that* well." One loses the ability to be pleased with one's self for acts that one considers wrong. For example, most people would not be able to take pride in even the greatest skill as a pickpocket.

The adult's aim usually is toward achievement in his career, which includes his vocation and his avocations. He seeks the thrill of using his powers to advance his personal and social aims. Whether it be running an organization, writing poems, bringing up children, copying a manuscript without error, or trying cases in court—when powers are fully used, it is always a source of euphoria.

Failure to Attain Euphoria Through Achievement. There are many who are inadequately impelled by the achievement motive. This is often because it has been sidetracked by some other motive. For example, fear of failure may be so strong as to prevent trying for success (e.g., the

student who will not take up tennis because others who are already proficient might look askance at a beginner).

Frequently, people like themselves better in the martyr role than in the titan role, and actually prefer not to get pleasure in doing what falls to their lot, but to pity themselves for having to do it.

Frequently, also, the motive of accomplishment is lulled by a false sense of superiority already present (as in the case of those who have been spoiled); or by joys of the senses (as in the libertine, alcoholic, etc.); or by a life of phantasy (as in the daydreamer).

A zest for achievement may also be missing because one has never experienced euphoria through achievement. One who has never done anything sufficiently well to feel a glow of real pride would naturally not appreciate the rewards of achievement, except perhaps in terms of money and the like. (That this is the case with many people is made evident by the fact that it is usually supposed that if a person works hard it is because his income would stop if he did not.) A succession of half-done chores all through childhood would certainly not cause an adult to know much about this important source of euphoria.

A faulty attitude toward taking pride in one's accomplishments may effectively inhibit achievement. Such maxims as "Pride goeth before a fall," and such warnings as all children receive against conceit (which is false pride) have made many people feel that they are at fault if they permit themselves to feel proud of what they do—except perhaps of some extraordinary and popularly acclaimed achievement.

With unhappy people, the main difficulty often is that they fail to use the opportunities that arise every day for giving themselves euphoria through using their powers. One of the fundamental rules of mental hygiene is that one should do something every day to the best of one's ability, even though only a little thing, and enjoy to the full the glow of euphoria it gives.

How High Should Ambitions Be? Normally, ambition will be gauged according to capacity. On the other hand, the inferior may "hitch their wagons to stars" and the superior may hitch them to nothing. In either case, the difficulty may be that they misgauge their capacity. In the case of the superior, the difficulty may be that they rationalize themselves into feeling inferior, in order to defend themselves against effort and responsibility. If a person can persuade himself that he is inferior, he will be justified in demanding less of himself. If he granted his abilities, he could hardly fail to be impelled by the principle of "noblesse oblige."

By ignoring and hiding them he can have an easy life following obvious leads toward pleasant paths, and neither he nor others can blame him.

For the sake of mental health, it is highly desirable that an individual learn through competent advisers how far he could probably go. Mistaken ambition may cause a person to center his attention upon a great and distant goal impossible of achievement, to the neglect of nearer, smaller goals that he could reach and that would give him satisfaction and serve the world's needs well.

Sometimes big aims must be frankly given up, for the time being at least. Giving up is not always a negative thing, but often a positive achievement of great psychologic value. To admit any disability may take more courage and clearness of thought than one possesses. Yet at times the whole future of the mental health may demand it. In such circumstances, giving up is not cowardice and retreat, but bravery and a step forward.

It is a common habit to scorn little achievements. Sometimes this is a good thing; sometimes not. Some achievements are really trivial in the sense that they do not fit into the picture of life in any way. Many a lofty ambition has failed to be reached, and many a career ruined, by not scorning little achievements. When the results of a big undertaking are slow in coming, a person may busy himself with irrelevant small tasks that can be done promptly and give tangible evidence that something at least has been done. For example, a man may neglect to "plug away" at his job and satisfy himself by tinkering with his car.

Many little achievements, however, are not really little, and are not to be scorned. Often they are part of a large whole, and derive significance in proportion to the significance of the whole work. For example, in the case of the student, every fact learned and theory mastered, every constructive idea developed, although in itself little, can be accepted as a source of pride because it is a part of his larger educational and cultural whole.

Similarly, in the case of the "cog in the wheel" of industry, business, or the like, each is entitled to feel that the whole work depends upon him, and to be as proud of his "small" part as if he had done it all.

The unhappy often need not be so if they did not feel that the immediately available sources of legitimate euphoria were too trivial to accept.

Meeting Failure. The sense of failure is so painful a one that it is likely to be banished by rationalization. A person who has failed often

"knows" exactly where the blame belongs. He says "I never had a chance; the cards were stacked against me." The wrong cards he blames were poor heredity; poor training, for which his parents and teachers were at fault; too many burdens unfairly placed upon him by poverty and dependents; no friends to push or pull; or false friends who stood in his way—anything or anyone except his remarkable self. The phrase, "If it had not been for . . ." springs to his lips in instant excuse of himself whenever he frankly fails or does not win the complete success he feels he deserves. Naturally, he is likely to continue to fail if he never admits nor corrects the faults that cause his mistakes.

On the other hand, there are some who react even to a small failure by a profound, wholesale self-condemnation. Each failure gives them a conviction they are "no good." Sometimes this tendency is due to the mistaken notion that it is possible to go through life without ever failing. Sometimes it is a persistent effect from severe censure of trivial failures, considered important ones, early in life. Often it is present in those whose self-respect is not on a very sure footing.

What both of these types of individuals often need is to make a point of frequently weighing their failures against their successes and as frequently admiring themselves for the latter; or, if the successes are few, revising their methods of fulfilling the achievement motive.

Is "Pride of Possession" a Legitimate Goal? The desire for possessions has been one of the important reasons why man has worked and striven and risen in the cultural scale. Possessions have value in terms of physical comfort, reassurance against want, the ability to render service to others, and, last but not least, they act as symbols of the worth of the possessor.

Unquestionably, possessions are a legitimate goal, but there is psychologic danger involved in allowing possessions to symbolize personal attributes. Of course, it is true that having many possessions may be evidence of intelligence, hard work, persistence, and the like; but it may mean nothing of the sort. A person may be of extraordinary worth to the world and yet have not "where to lay his head."

Certainly to gratify the ego only, or chiefly, through what is essentially outside itself, often results in failing to gratify it in more vital ways. It is desirable to be on guard lest one identify one's self too closely with one's possessions. Many a man has felt that he amounted to nothing when his possessions were gone, and sometimes it has proved to be true.

To Feel Liked and Approved

For two reasons everyone desires to be liked and approved at least by some others in some way and degree. The desire springs from the ego impulse to obtain anything that contributes to personal welfare and happiness, and from the social impulse to be in accord with one's fellows, as will be mentioned in Chapter 17.

For the ego, the chief value of being liked is that it reinforces self-esteem. The individual uses his associates as mirrors to reflect himself, and is pleased if the image they give back confirms his own good opinion of himself. Few people can really like themselves unless others like them. Conversely, few fail to feel a certain amount of dysphoria upon receiving clear evidence that they are not liked.

Popularity as a Legitimate Goal. The term popularity has a rather poor connotation in the minds of many people because it is so often pursued for faulty reasons and by faulty methods. The primary definition of popularity is being liked and esteemed by many people or the whole population. Whether or not popularity is a legitimate goal depends upon those whose liking is sought, and the methods used to obtain it.

There can scarcely be a higher goal than general social approval obtained by becoming genuinely likable and admirable according to wide, socially accepted standards. It can hardly fail to bring about an adaptation at a high level, and a corresponding degree of mental health.

To seek popularity with a limited group may have equal value or it may not, according to the level of the group. To seek popularity from any source by any means other than real worth is invariably unsatisfactory to mental health.

Some people believe that they should ignore any evidence that others do not like them, saying "What do I care," as if the answer were "Nothing at all." That will not be the reaction, however, of the thoughtful person accustomed to confronting unpleasant realities frankly. He will ask "*Do* I care?" Specifically, he will ask, "Is the disapproval from someone whose opinion is worth considering? Is it only one person's opinion, or do many concur in it?" And finally, he will ask, "Do I concur in it myself when I consider myself honestly?"

If the answer is, "I do *not* care," it is necessary to be sure that one has not been rationalizing. If the answer is "I *do* care," steps of one sort or another will usually be taken to rid one's self of the unpleasant feeling of not being liked.

On Not Being Liked. When one discovers that one is not liked and the feeling rankles, there is a tendency automatically to rationalize the feeling away. For example, some people rationalize, "If that person does not like me his opinion cannot be worth considering. He is prejudiced, not fair, he does not really know me, or he has some axe to grind." When one had respect for the person before he expressed disapproval, and loses it only afterward, the change of attitude may be suspected of being rationalization. This reaction is very common indeed. It is like discrediting a measuring rod because it does not measure the number of inches one wishes it to.

In reaction to an adverse majority opinion, one may rationalize that the majority consists of average people, not capable of appreciating a person as much above the average as one's self. Many people convince themselves that it is a mark of distinction not to be widely liked, arguing that only tepid, neutral people can be generally popular. They are personally satisfied if they feel that they stand out from the herd and therefore are necessarily not popular with it.

Sometimes such arguments are not entirely rationalization. For example, if one is thrown with a group totally different from one's self—a group less intellectual or with lower moral or social standards—one would not expect full appreciation of one's worth. Nevertheless, popularity usually is based upon personality qualities that even the inferior recognize and respect in others even though they do not possess them. Many a prison warden, for example, has been really popular among those in his charge who are entirely different from himself but quite able to recognize certain fine human qualities when they see them.

Usually it is merely bravado to assert that one does not care to be popular among associates. A more constructive attitude would be to conclude that one actually is not likable if the majority of the people one knows does not find one so.

When they realize that they are not liked, many people do nothing but mope or brood over it, or wish idly that they were "gifted" with popularity, which they consider an esoteric something that either is or is not there. Others turn against the people who dislike them and try to get even with them, perhaps by trying to tear down their own claims to esteem. Many shut themselves off as completely as possible from anyone who shows dislike. At the first breath of criticism, some people will even break a lifelong friendship or a family tie. The normal tendency

is to attempt to become more popular by one of the several approaches to that goal.

To become popular a person may say "I am what I am," and then seek out for his friends those who like that sort of person.

Or he may use camouflage to create a good impression. Camouflage involves affecting or pretending qualities one does not possess (e.g., acting as if one had more culture, more sophistication, higher morals, a kinder heart, different opinions). A person may become a veritable chameleon, changing his personality color to correspond with his associates, being "all things to all men." Many "personality" courses of lectures and books are designed to aid one in this questionable mechanism of "putting up a front." Essentially, all camouflage is deceit. Even frank dishonesty may be used for the purpose of appearing well in the eyes of others; in fact, lying is perhaps done more often for that purpose than for any other.

Or he may change himself so as to be the sort of person that respected people like and admire.

Can One Be One's Self and Be Popular? The phrase, "Be yourself," implies different things to different people. To some it means making use of no standards outside themselves, but merely following their inner urges, whatever they may be. When used in that sense it is indeed bad advice for the person seeking popularity, for inner urges not constantly checked by the standards of mankind in general can hardly fail to produce exceedingly unlikable, not to say obnoxious, persons.

Often persons guided only or chiefly by their impulses are puzzled to know why they cannot make friends, or why, having made them, they cannot keep them. As a result of much advertising they often mistakenly think first of soap or dentifrice as a probable remedy.

If such persons are "popular" at all with those who are exacting, it may be because of some one trait (such as a sense of humor) that causes people to tolerate all their objectionable traits, but not really to esteem them.

Persons finding themselves unpopular with people of high standards, and badly needing to feel that they are liked, often find that the easiest way to gain that feeling is to limit their association to those easy to impress—inferiors of no particular standards; or those with the same limitations as themselves and not too critical; or those who feel flattered by their attention; or those who have something to gain through putting up with them. Those who are bound to be liked by somebody, no matter

whom, are likely to make irremediable mistakes. For example, they may conform to the standards of others when they do not approve of them, in order to retain their popularity. Much alcoholism originates as passive compliance for "friendship's sake."

If the phrase "Be yourself" is interpreted to mean "Be your best self," then popularity, in the sense of being widely approved and esteemed, will inevitably be the result; and in addition, popularity in the sense of being genuinely liked by one's immediate associates, if they are the right sort of people.

Of course, the aim should be to develop a self that can "be itself" without any danger of losing the esteem of anyone worth consideration, and without any need for trying to "create a good impression."

The Implications of Friendships. Ordinarily it is a sign of poor mental health either not to want friends, or to want them and not be able to make them, or to make them and not be able to keep them. For mental health, the aim should be to have many friends, lasting ones, of many different sorts.

The one thing that is most likely to interfere with friendship is self-interest. Some so-called "friendships" are made almost entirely on that basis. "Friends" are chosen, for example, for the "pull" they afford, for the domineering they put up with, or for the homage they pay.

The person who cannot believe in himself unless others do, makes a particularly poor friend. He is so eager for praise that his friends finally become weary of thinking up new ways of complimenting him. To stand well with his friends, he may flatter and fawn upon them in a fashion that repels all except those whose ego also needs salving. He is sensitive and "touchy" and has to be handled with gloves lest he feel that he is being made fun of or insulted. And he is jealous of his friends' other friends.

When a friendship fails it is usually because either or both demands far too much for himself from it.

Propinquity should not be scorned as the basis of a friendship. It usually implies that the two have something in common beyond the fact that they are human beings, and it may be a good test of one's mental health to be able to create a pleasant friendship with those in whose company one is thrown by chance (e.g., a college roommate).

The best friendships arise upon community of interest, upon which develops real liking and esteem, each for the other. In such a friendship, the ego of each can hardly fail to gain satisfaction, but that will not

be the sole reason for the friendship. In a real friendship, there will be reciprocal give and take—each does much for the other, but conversely, each usually must bear something from the other. Probably few friendships are ideal in all details, as many people expect them to be; but any real friendship should be valued and guarded as one of the boons of living.

To Feel Safe and Secure

Parallel with his many impulses to "do and dare," man has an impulse to keep safe—to stand fast, or draw back, in avoidance of possible danger.

Gaining a Feeling of Security. Normally, the safety motive counsels due caution and prudence regarding the new and unfamiliar, and thereby acts as a balance against the motives that otherwise might lead to recklessness. It is a conservative trend, having a stabilizing effect.

When exaggerated, the safety motive may be seriously hampering, if not actually paralyzing, to full development, by causing a person to prefer only the familiar, the tried and true, in all relationships and situations.

For example, if the dominant motto is "Safety first," it may act as an obstacle to achievement. The individual who is bound to feel secure at all costs is likely not to try his powers lest he be laughed at or criticized. In choosing a career, he may choose easy work in which he knows he can succeed rather than risk the humiliation of failure in anything more ambitious. Or he may choose work that he despises and that gives little scope for his powers, if it provides a small but sure income. Or it may make him reluctant to take up more promising work if it throws him into a new environment with new people. While holding a position in which he has become settled, he may even temporize with his convictions in order to remain comfortably and securely established.

Similarly, the safety motive may cramp social relationships. It may cause one to shun association with others lest one's feelings be hurt, or, if not to shun them entirely, to be timid about going half way in making new friends. Shyness usually is the safety motive greatly exaggerated.

So also are family fixations, those that tie a person too closely within the protective and admiring family circle. Many a person first attempting to branch out into a life away from the childhood home feels a strong pull backward to the former settled security. "Homesickness" may even be so intense as to break up a college course, a career or a marriage.

Valuable as family life is, in the support it gives its members, it must usually be dispensed with to some extent as one begins to grow up. Reality requires a certain amount of emancipation from parents and home. But in freeing one's self from bondage to the familiar, one is not, of course, doing violence to his affections, but merely developing them to an adult level, at which level they can be acted upon in ways that give greater satisfaction both to the individual and his family. In fact, the role of the childhood home is to equip its members to leave it ultimately and stand on their own feet.

When sublimated, the safety motive supports loyalty to noble tradition, faithful friendships, firm family ties, and steady, well-seasoned policies in business, government and personal affairs.

17

The Societal Impulse

The Social Organism

The individual multicellular organism, with the ability to use muscles and mind for adaptation, is in a favorable position for survival, but it can make its position still more favorable if it can establish friendly and helpful relationships with others of its kind.

Many species of animals that formerly inhabited the world are now extinct for one reason or another, but some species have been greatly aided in survival because they developed a most successful means of adaptation—that of banding together for mutual aid and protection. In such species, the individuals live in groups and coöperate in certain tasks (e.g., wolves hunt in packs). Among some species (e.g., bees; termites) survival is still further promoted by a division of labor.

When individual organisms pool their interests and establish division of labor, relatedness increases among them, and each individual organism becomes a unit of a larger unit—the social organism.

Society Likened to the Body. Relatedness among human beings is exactly parallel to the banding together of the cells in the body, whose relatedness each to each is the basis of their life, and whose coöperation is the main determining factor in their increased chance of survival.

Just as each single cell in man's body affects all other cells and is affected by them, so each human being affects the social organism and is affected by it.

Just as some of the energy of his unit cells must be used for their own upkeep and some for the upkeep of the whole body, so must some of each human being's energy be used for himself and some for the group of which he is an integral part.

Just as the cell's individual use of energy must be in harmony with

that of all the other cells, so must the "selfish" activity of a human being be in harmony with that of other human beings. An ego each must be, but a social ego.

Finally, just as each unit cell in his body profits by the welfare of the whole body, so he, a social unit, profits by the welfare of society in general.

Is Complete Individualism Possible? Man has established relatedness in all his affairs to such an extent that one individual would find it difficult even to try the experiment of living quite independently, to say nothing of carrying it through successfully. The things that he would have to do without, if he ceased to be dependent upon his fellows, would prove his undoing in a short time, just as no part of his body could live for more than a brief instant if detached from the rest of the body.

However it came about, we do live in relationship with others; and whether or not we wish to influence others, we do, and are influenced by them. And whether or not we wish to consider others, we *must* consider them or with them face failure and extinction. The societal impulse, with its leading toward social coördination, has a sound biologic basis.

Social Traits

Man's Social Traits. The necessity of association and coördination has endowed human beings with certain characteristic traits. First, human beings "naturally" want to be together; they are essentially gregarious This may be called the propinquity motive. Second, human beings like to do things together, forming themselves into organized groups for the purpose. This may be called the organization motive. Third, human beings like to resemble each other—to be alike, think alike, and act alike, or to vary only according to group standards. This may be called the conformity motive. From these roots there may arise, finally, a sublimation which causes the individual to wish to serve others and the group welfare.

In their manifold manifestations these tendencies are capable of leading human beings to the highest level of adaptation to life, and the highest happiness. Even in lesser ways, they are the source of much of man's development and his everyday satisfactions. At the worst they may be as destructive as any tendencies man has. The tragedy, however, is the absence of the social impulse, its absence failing to unite the individual in any significant bonds to mankind.

The Propinquity Motive. Most people feel somewhat lonely if they are not near others, even though not actually with them. In some persons this motive is so heavily accented that even a few minutes alone will plunge them into misery. Some normal persons appear not to feel the need for companionship so keenly, but in general the "solitary"—the hermit type—is somewhat abnormal. Certainly the normal individual seldom either fears or craves solitude; he enjoys the society of others and likes to be in groups, but also likes his own company at times.

The Organization Motive. Human organizations, ranging from the small boy's "gang" to a great nation, represent the human desire to do things together. Beginning early in life the individual finds himself banded with others of his kind in most of his activities. Our civilization is based upon the principle of group organization.

The normal person allies himself with organizations of many kinds because he likes the groups and feels akin to them, because he appreciates the social function of the organizations and wants to share it, and because he likes "teamwork."

When not guided, the "belonging" tendency may govern behavior disadvantageously. For example, it may produce the "joiner" type, male or female.

When sublimated, the societal impulse leads toward the union of the individual with organizations of the widest scope and the greatest significance to him and to his fellows. Such a group may not be large, but it will represent something socially large in the sense that it is socially constructive, not disruptive. Such qualifications may be possessed by group activities organized for recreational, business, professional, or any other purpose.

The Conformity Motive. In spite of a strong ego desire to be himself nearly every human being also has a desire to be like others—others of his own personal group thrown together by propinquity or chance, or others of a chosen group, chosen either because they were like him at the start or represent what he wants to be.

It is, of course, easier to do as others do—to follow the crowd. It saves the labor of making personal decisions. But the root of the desire for conformity is in the euphoria that comes from a sense of harmony with others. To conform to group standards cements our union with the group; we "belong" and expect to continue to belong as long as we continue to conform. We are spared painful criticism or ridicule, and we gain, as we hope, the approval of those whom we resemble.

The desire for conformity exhibits itself in four major ways—externals, manners, opinions, and standards of conduct.

WHY DO WE CONFORM IN EXTERNALS? Human beings obviously wish to be somewhat alike, if not exactly alike, in externals—such matters as style in clothing and hairdressing, cars, houses, interior decorations, and the like. Frequent changes of style furnish an opportunity for the individual to obtain repeated evidence that he is still eagerly following the group, and belongs to it this season just as he did last.

Conformity in externals is a great comfort to many an individual, but also it may be a source of misery if he cannot conform as fully as he would wish, or if he sacrifices too much else to his need for conformity—for example, his financial security. It is a notable fact that the ego will give up many of its demands for the sake of the euphoria that comes from even this lesser evidence of kinship with one's kind. Regarding esthetics as expressed in personal adornment, for example, the ego may gladly give up its desire for beauty if only the conformity motive can be gratified.

To be "different" in respect to externals, especially of appearance, places a person under suspicion. A man who wore a straw hat all winter would certainly be considered "odd," to say the least. His doing so might indeed represent an extreme reaction against following the social impulse, and it might be a symptom of a diffuse failure to balance his ego impulses with his social impulses. Yet it might be his one gesture of independence.

CONFORMITY IN MANNERS DESIRABLE. In the sphere of manners, conformity is certainly highly desirable. In any epoch, good manners are the manners of a person of fine nature—they comprise the way such a person naturally behaves. More people appreciate such manners than can spontaneously exhibit them. Therefore, parents in all lands always consider it important to bring up children to have the manners of naturally well-behaved persons. This tendency to respect the best in manners and to emulate it, leads to a smoothness in social intercourse that otherwise would not exist. It is fitting indeed that those who are so uncouth that they would not have good manners of their own initiative, and would go about making themselves objectionable to those of good taste, should strive to the utmost for conformity with the approved standards. Mrs. Emily Post's book on etiquette has made many an otherwise boorish person tolerable. It is better to ape good manners than not to have them.

Yet the letter of the law rather than its spirit may become a fetish with those who feel no assurance within themselves. Some would almost rather be caught stealing than using the wrong fork at dinner. A girl dismissed a young man in hauteur because he failed to rise when she entered the room for the fifth time in an hour. Many young people never introduce anyone to anyone else because they are afraid that they will not do it correctly.

Dean Swift once observed: "Good manners is the art of making those people easy with whom we converse. Whoever makes the fewest persons uneasy is the best bred in the company."

CONFORMITY OF OPINION AN ADVANTAGE. There exists in most human beings a desire for conformity to the opinions of others. In spite of cherishing most highly the wish to use our own brains and to do our own thinking, most of us, in many respects both large and small, are compellingly drawn toward agreement with our group.

Almost all groups, with or without marked intellectual interest, tend to develop opinions on most matters. A member of the group listens avidly to what "they say," and then says "I think." Outside his own sphere of knowledge (e.g., jurisprudence, if he is a lawyer) he often does not think at all, but merely echoes. He is bountifully supplied with opinions by this easy method of inoculation—indeed, perhaps much more bountifully than would be the case if he had to think for himself in order to reach conclusions. Since he cannot admit he has not used his brain, he persuades himself, by rationalization, that he really agrees with what his associates think. A nation-wide depression or a war may be due to that type of conformity to unfounded diffuse opinion.

The tendency to think alike has its root in the obvious advantage in group life of unanimity of opinion among its various members. It makes for united action against any common foe and it promotes comfortable living within the group.

The major matters upon which society as a whole has opinions are those regarding the conduct of individuals with reference to other individuals and in reference to group welfare. It is these opinions in particular with which individuals as a rule feel compelled to conform.

Social Standards

A social organism has its own life to protect, and it must have the coöperation of its unit members. Just as the human body will be destroyed if any of its groups of cells carry on independent activity not in accord

with the whole body's needs (as in cancer), so will the social organism be destroyed if its individual members become, like cancer cells, asocial or antisocial.

Enforcement of Social Standards. From earliest times in history there has existed in every group a force that may be called public opinion. It represents the crystallized sentiment of the group regarding what is good for it and what is not—what individuals may do and what they may not. Primitive peoples everywhere have their accepted modes of behavior. The Latins used the term *mores* to describe the customs and habits, manners and ways of life that were common to the group. The term survives in our word morality, which implies right ways of behavior—the sort of behavior that favors the social welfare.

In order to have no misunderstanding about the sort of behavior that was not acceptable, the human race early began to record some of its established standards as laws. Many of the first recorded laws for the regulation of human conduct are still the laws of the civilized world.

Today, public opinion is expressed in the same two ways as of old—the mores, or unwritten but established and binding customs regarding relationships between individuals and of individuals to society as a whole; and the mass of codified laws and statutes, and the common law. As of old, the written and unwritten rules of behavior represent what society believes to be to its best advantage.

Individuals making up the group normally tend to listen to whatever is clearly the voice of society as a whole, and to follow its guidance. They obey a law either because they themselves believe it to be sound, or because they respect the opinion of the majority, or because they wish to feel in harmony with the group, or because they see a personal advantage to themselves in the working of the law—or, if for no other reason, because they fear the punishment society will inflict if they break the law. All these reasons are powerful also in enforcing unwritten laws of all sorts.

Rebellion against Social Standards. Often a person feels the pull of the herd more strongly than he likes. He may sense the fact that if he admitted how much he owed to society he would feel bound to satisfy its demands upon him, or that if he admitted social standards were right he would feel bound to conform to them. To free himself of such obligations he calls himself an individualist. He may feel that he stands apart from the group because he is "different" from the mass—the hoi polloi, as he calls them. Or he may include others with himself and become an iconoclast of the whole social system. The latter often call themselves

radicals, but to the extent that they stress what they are against rather than what they are for, they are merely rebels. Some are merely dreamers, idealizing a future blissful state of mankind upon earth. To them, everything in the present seems wrong, and they fancifully hope and believe that what they dream can be brought to pass by magic. The Cinderella rather than the Hercules fable buoys them up.

Individual Conduct Regulation In Lesser Groups. In smaller groups—such as communities, organizations, professional groups, social sets, and even among gangs of crooks—what is "done" and "not done" has all the force of law. These are standards that can be violated by the individual only at the peril of ostracism or exclusion, or loss of "standing" or reputation.

In some limited groups the standards far exceed those of society as a whole. For example, in many professions the code of ethics far transcends the law of the land and even the generally accepted standards.

In other groups, lower standards prevail; they may deal only with trivialities or be restricted in range, or they may ignore or even run counter to the standards of society as a whole. Yet conformity to the petty or low standards of a group may fully satisfy the individual's poorly sublimated social impulse.

Perhaps the greatest danger for the average individual is in feeling too keenly the force of petty standards, and satisfying the social impulse in these limited ways. Many individuals, for example, feel the social impulse in no way so strongly as in their desire to be like their associates in externals. A boy may refuse to drive the family sedan in a year when his "bellwethers" are driving club coupes, or a girl may refuse to entertain her friends at home if she cannot do so according to the prescribed ritual of her group. In many respects, the temporary and insignificant euphoria of petty conformity may stand in the way of wider adaptations on the social level.

Social Development

Conflict Between Ego and Societal Impulses. Obviously, there are the elements of mental conflict in the fact that ego impulses and social impulses may pull with equal strength in opposite directions. The social need to act with others is matched by the ego need for independent action; therefore, we have two tendencies, to keep with the group and to leave the group. The social need for being in harmony with others is matched by the ego need for individuality; hence we wish to be like others and to

be different. The social need of working for the group is matched by the ego need of working for one's self; hence we have tendencies to be selfish and to be unselfish. Every slightest ego wish may be matched by a social wish counterbalancing it. Conflict invariably ensues and must be solved.

In childhood the most vociferous demands are likely to come from the ego, but the child normally begins to develop affection for and interest in those near at hand, and to be more and more stimulated by motives springing from his social relationships. In a normal environment and with favorable training, a normal individual can hardly fail to develop a constantly increasing feeling for others, and an increasing tendency to try to harmonize personal wishes with those of his associates.

Defects of Social Impulses. It is believed that the social impulse is present in all normal individuals having normal experiences. In some persons, however, it appears to be absent in spite of circumstances that normally awaken it. Or, if awakened at all, it may express itself in the most rudimentary and superficial fashion in support of the ego rather than in opposition to it. For example, it may make a person "sociable," but chiefly for the pleasure it gives him.

All our social institutions and our mental hygiene are based upon the assumption that the social impulse is actually present and can be developed to be a counterbalancing force in the personality, checking and directing the responses to the ego impulse and the sex impulse. Yet, whether by inborn nature or by acquired defect, there are among us many personality cripples, lacking the force of any strong feeling for others. Possibly we shall not solve some of our social problems until we recognize that even those who are normal in intelligence may be deficient —and perhaps hopelessly so—according to personality norms.

Those lacking a developed social impulse constitute the greatest drag on civilization. At best, such a person is asocial, neither for nor against the social welfare, but virtually against, since he is not for. At worst, he is antisocial and turns his hand against society in criminal acts, or he becomes mentally ill. It is perhaps lack of social feeling more than anything else that distinguishes the mentally ill from the mentally well.

Nevertheless, it can never be certain in the case of a child how far he can develop until every effort is made to discover early signs of faulty development and to correct it.

Social Development. It should be suspected that a child is not developing due social feeling, (1) if he wishes always to play by himself; (2) if,

when he does play with others, he must always dominate them; (3) if he feels that he is different from and better than others; (4) if he feels that he has special rights; (5) if he becomes at odds with the group and feels that it is against him; and (6) if he manages to set members of the group against each other, or the group against other groups.

Also, the normality of development should be questioned if a child, although highly "sociable" and gregarious, does not sense anything of the contribution that others have made and are making to his welfare, or the contribution due from him to others—in other words, if he does not acquire the concept of "give and take," but only of "take."

How Is the Social Impulse Sublimated? At his highest level of development, the individual identifies himself not only with those near him, but with the social organism as a whole—with all humanity. He sees himself as he really is, a self among other selves, but not a separate self. He and humanity are one. And his self gains dignity and worth from this concept. His ego yields its demands to a superego identified with all mankind. Conflict no longer exists, for what the self wants is what the social organism wants. Life at last becomes "plain sailing" and all the energies may be used in navigating toward a clear goal.

One of the best examples of the sublimation of ego and social impulses, and their harmonizing as one impulse, is the life of Pierre and Marie Curie, who labored endlessly, using their great powers in work that at one and the same time was fulfillment of themselves and fulfillment of the needs of mankind.

It is not within the power of many individuals to give to humanity as did the discoverers of radium. Yet society needs to have each of its members fulfill his own destiny in the same spirit of accord with the common good. Whatever a person's level of ability, there can be no question that his level of adaptation is the highest when he sees himself and mankind as one, and acts for his fellow man as for himself.

It should be noted that this conclusion regarding adaptation to life, reached through the study of psychobiology, corresponds closely with that reached through the study of ethics and religion.

Traits of the Socially Minded. In everyday life among everyday mortals, the socially minded person says "We" as often as he says "I." He is happy in being with others, but he is also happy alone. He likes to be like others in ways that make for comfort and harmony, but he also likes to be himself at his best. He likes to be in agreement with others whose opinions he respects, but he is willing to do his own thinking and stand

by his considered judgments. He is willing to work for group interests as hard as he works for his own good, and to pull his share of the load in any group undertakings. He thinks of the rights of others as often as of his own, and surrenders his own rights when asserting them would harm his associates.

Specifically, he will observe the laws of his land, believing that on the whole they are fair to all. He will work to advance group interests and to promote social welfare in any ways within his power. He will have a part in public works of various kinds (education, public health, etc.) and in group organizations representing humanity striving for high aims (religious, political, charitable, etc.). His interest in the public good will not be theoretical and remote, but practical and near at hand. He will do, as well as dream; and he will do what is up to him to do, even though his part is not large and conspicuous.

He will be a good citizen. He will help to run his community and nation by means of the ballot, and his vote will not be based upon rumors and propaganda and prejudice, but upon all that he can learn from direct sources (e.g., the platform of the various political parties, not only his own). He will fight for his country on military or civilian fronts, according to his ability. He will be a good neighbor, sportsmanlike in suppressing his own interests if they conflict with those of others (e.g., he will keep his radio turned low, and keep his sidewalk free from ice in winter, etc.). Last but not least, he will be a good friend, and in his own sphere try to promote kindly relations and harmony among his fellow men.

All these things the socially minded person will do not only because he thinks it is his duty, but because he will not be comfortable unless he does them, and because he will be extraordinarily content if he does.

It is obvious that there is a vast difference between the blind and heedless follower of the herd's more superficial wishes and the one who tries to learn and to follow the spirit of the social impulse, which is, in little and big ways, each for all and all for each. The foundation of mental health is the recognition of the greatest reality of all—the brotherhood of man.

18
The Sex Impulse

Attraction, Love, and Marriage

One of the most striking features of life in all its forms is that it seeks not only its own continuation but also that of the species to which it belongs. Survival of the species, like that of the individual, is made possible by the inborn tendency to be stimulated in given ways toward given acts. The tendency is based upon certain sensory urges and their emotional counterpart—together called the race preservative impulse because it serves to ensure the propagation of the race; or the reproductive impulse, since it leads to reproduction of individuals, whereby the race is preserved; or the mating impulse, since mating is the means by which reproduction and race preservation are accomplished; or the sex impulse, since it is because of sex interests that mating is desired.

Like all native impulses, the sex impulse establishes a state of dysphoria in order that action shall take place to produce euphoria. The dysphoria it creates may be sensory or psychic or both, and may be slight or pronounced, according to the individual in question and to the stimuli to which he is subjected. The euphoria it seeks may also be sensory or psychic. The impulse may be repressed or diverted from its natural goal; or its natural goal may be sublimated by means of voluntary control.

On the sensory side, sex impulses arise early in life, but are not urgent until puberty or after, when the reproductive glands affect the whole organism in such a way as to accentuate them. On the emotional side, sex feelings do not develop as such until after puberty, at which time there develops normally both a physical and a psychic attraction to the opposite sex, which leads sooner or later to the phenomenon of "falling in love."

Physical Attraction. On its simplest and most fundamental plane, the attraction that leads men and women to mating is physical—that is, it arises and culminates through the senses. Usually the first sense to be aroused is the visual. Through the eye two people first become aware of each other, and impressions thus gained may at once determine whether further attraction is possible.

The determining factor may be not merely the appearance as such, but what it is felt to indicate biologically. In a matter involving race preservation it is natural that there should be more or less universal standards of beauty based upon what is good for the race. These unconsciously influence men and women to choose mates whose appearance seems to indicate that they are fit for parenthood. An appearance of health and vitality, of normality and soundness of body and mind, is virtually essential to sex attraction. Form and feature, color, carriage, expression —all must have this significance. An associated factor of great importance is cleanliness, which has the same esthetic and biologic significance. Only in the most sensual is sex itself enough to arouse attraction, appearance being unimportant.

However, the sex impulse is still more selective; the determining factor in attraction usually is a highly individualized preference. Regarding appearance, beyond the factors of biologic significance there are factors which, to a given individual, are of great personal significance. Individual preferences—as, for example, for blondes or brunettes—defy explanation; and when it is a question of preference for a given individual, they may be quite unaccountable according to any esthetic standards. Furthermore, individual preferences extend to senses other than vision; the olfactory sense and the ear are, for many, as exacting as the eye.

Important as physical attraction is as a basis for mating, civilized human beings are inclined to feel that in itself it is not enough; it must be part of a more diffuse attraction of personality and intellect, or it is not love.

What Is Romanticism? Sometimes attraction remains at the sensual level but becomes surrounded by an aura of romance, the product of the phantasy mechanism. The personality of the beloved shines with the light of one's own imaginings. Unconsciously one endows the other with qualities he or she never possessed. This is done to justify one's taste; one must feel that this is not an ordinary person whom one has captivated.

There may be virtually nothing real upon which such an attraction is based, except the appeal of the senses, and even that may be minimized

in order to make the attraction seem on a high plane of idealism. This is the sort of "love" commonly known as infatuation. Usually it is transitory; as a rule, the more brightly it glows for a time, the shorter its duration, and that is fortunate, for real love is not founded upon fancy but upon fact.

Many individuals upon first experiencing a sex attraction of great intensity are inclined to believe that it is the only emotion of that kind that they will ever feel, and to believe that if that romance does not culminate no other ever will come to them. As a consequence, they are very much in earnest about it, worried about the outcome, and sometimes marry on the basis of such an assumption, perhaps against their better judgment. It is quite a mistake, usually, to believe that this sort of love can be aroused only by one individual, or that it comes only once in a lifetime or that it necessarily means love. It appears to be rather the exception to fall genuinely in love with the first individual who arouses one's emotions.

What Is Love? At a higher level of attraction is the emotion that deserves the name of love. It is not "blind" as tradition has it, but clear-eyed. To be sure it idealizes, but does not exclude a concept of the real person. Since it does not depend entirely upon illusion, it is more likely to be lasting. Also, real love is sublimated beyond the sensory and selfish level, and is not only a sensual and romantic relationship, but a companionship as well. Finally, real love is altruistic. It seeks at all costs the welfare of the one who is loved. In those who are capable of it, such love throws a glory around life that is not dimmed even by the renunciation of all that is personal.

Success in Marriage. Marriage should be undertaken only when love is present, and when, from all points of view, the marriage contract seems to be a sound and expedient one, and one which can be fulfilled by each of the partners. Under such circumstances, it should be the most perfect of human relationships. It offers each partner a warmth of devotion and appreciation and sympathy, a closer bond of understanding, than comes from any other association. It is worth whatever it demands of each in the way of compromise. Naturally, however, the perfection of marriage does not spring into full bloom at once, nor remain so, without nurture.

The emotion that draws two people together in marriage will give them the intention to adapt to each other and to whatever their life together involves. But intention is not enough. They must cultivate the ability to carry it out. Many significant details of getting along with others must

be grasped. For example, a husband and wife must understand even better than mere friends and acquaintances the little ways in which another's ego instinct may be gratified in everyday life; and particularly they must understand what the major satisfactions of the ego instinct, in the career, mean to each other. The support that married partners can give each other in self-realization is one of the flowers of the altruistic aspects of love. But, as has been said, to act upon emotions one feels for another, the emotion must be supplemented by knowledge and thought, planning and practice. A truly successful marriage almost always represents good mental health on the part of both husband and wife.

When marriages fail it is most often because they were founded upon phantasy, and when the phantasy collapsed one or the other partner was unwilling to let it go and adapt to the real mate. In such circumstances, naturally, incompatibility of tastes and interests appears. Generally speaking, incompatibility means poor personality adjustment between two people, either or both usually being poorly adapted to life as a whole as well as to the mate. It would appear that a psychiatrist should be sought instead of the divorce court when marital harmony is lacking—and this applies to lack of harmony on all planes, even in regard to sexual compatibility. The latter should be present when love itself is present; and it should persist.

Early marriage has been advocated as a remedy for the conflicts that arise around sex. It should be noted that this would remedy the situation only in some cases, for not all individuals are in a financial position to marry early; and even for those who can marry early the problem of sex is not necessarily settled permanently. The individual who cannot solve his sex problems before marriage should not count on having them all solved by marriage.

Denial of Sex

Is It Harmful to Deny Sex Impulses? Although it is normal and natural to marry and to have children, it is not unnatural to remain unmarried. In fact, the majority of persons do not marry for some years after they are biologically ready for it and after sex impulses have begun to be urgent. The question arises whether the denial of sex impulses before marriage is harmful.

This question has repeatedly been answered in the negative by scientific authorities such as the American Medical Association and the American Public Health Association. The latter organization states that

"continence in both sexes and at all ages is compatible with health and normal development." Pronouncements such as this have been made to overcome the popular impression that for men sex expression is a requisite of manly vigor. Not only is continence safe, but it is also possible, with men as with women, whenever it is not suitable that marriage should take place.

A second question often arises in the case of the unmarried: Even though continence does no harm, it represents the denial of a natural impulse, and why should it be denied?

For some persons that question does not arise. Denial of sex outside marriage is easy for them because they feel no sexual attraction at all except as part of the highest sort of love. They need not resist casual sensual affairs because such affairs would seem to them tawdry and dull—quite distasteful. Fastidiousness regarding sex and love is a trait not only of women; many men are equally repelled by the crudely physical or the spuriously romantic. It is a matter of fine discrimination in values, of a preference for only the best.

For many individuals, however, it is by no means easy to deny sex its natural expression. When they do so it is usually for one of the reasons to be mentioned in the following four sections.

Sexual Continence for Social Reasons. Many individuals deny themselves sex freedom because they respect the institution of marriage—the only socially sanctioned form of mating. They realize that it sprang originally from a genuine social need. It cannot be imagined that mankind would ever have set limitations upon natural impulses unless it had been the feeling of the whole group that such limitations were necessary.

In looking back over history, and considering the contribution of marriage to human progress, it appears that it has had particular value in respect to the rearing of children. The rights of the child are the basis of most of our highest standards, and it seems that there could hardly be a better foundation for the personal development of all concerned as well as for society. The family as a unit meets the requirements of the individuals that compose it and of the community that families compose, even though it does not always do so perfectly.

The advantages of monogamy have been questioned, especially by those who feel restricted by its bonds, but society has not seriously questioned its advantages as a means of promoting family welfare, social stability, and also individual happiness.

Those who deny themselves sex expression outside marriage respect

the theory of marriage and its value to the human race; and they desire to help rather than hinder the upward trend of mankind. They realize that the whole social structure is based upon the effort through the ages to rise above the level of action on unmodified instinct; and that the whole social structure is affected by each lapse from higher standards. Even though they can foresee no possible harm to themselves or any other individual, they are willing to deny themselves for a principle.

At a somewhat lower level, there are those who appreciate the practical aspects of society's attitude toward sexual nonconformists, and the punishment that in most social groups is visited upon them. Public disapproval, expressed by partial or complete ostracism, depends of course upon what is known about a person's private life; but it is notable that what is not actually known regarding a promiscuous person is usually suspected, and that the results are the same. In almost any group, a woman who violates the code will find her social standing and her career handicapped; and men are not exempt among social groups with high standards. While monogamy prevails, both men and women who fail to observe its obligations do so at their social peril.

Sexual Continence for the Sake of Marriage. There are many who respect the institution of marriage not only theoretically, but practically, expect to marry happily themselves, and do not want to put any stumbling blocks in their way to prevent or to mar their marriage.

They realize that affairs before marriage may cause a marriage that would not otherwise have taken place—and one that may be a poor substitute for the ideal marriage that had been contemplated with a quite different mate. Also, they realize that such affairs may prevent a marriage that might otherwise have taken place; even though marriage is contemplated, too great intimacy before marriage may cause the attraction to wane, especially if it is on the conscience of either. Premarital intimacy with one person may effectually shut off the possibilities of a marriage with any other person. This is either because the affair is so engrossing as to prevent one from making other friends, or because other possible partners, if they suspect the nature of the affair, may be repelled. Whether from possessiveness or jealousy or wholly from idealism, many people wish their mate-for-life to be, and to have been, only theirs. Certainly those who have casually overstepped the bounds, both men and women, often regret it when it later threatens the perfection of a lifelong relationship.

Sexual Continence for Physical Reasons. One of society's reasons for

not countenancing extramarital relationships is that they are likely to bring fatherless children into the world and to spread venereal disease. Both these dangers are decreased to the degree that strict observance of the standards of monogamous marriage prevail in a community.

Those who respect the physical danger of infection or of pregnancy are well advised. There are no preventive methods that can be implicitly relied upon, and those that exist are, for one reason or another, less reliable under circumstances of illicit relationships than within marriage. Although pregnancy outside marriage is more serious for women, it may cause serious complications for the man as well (e.g., an undesired and inappropriate marriage, and self-condemnation).

Sexual Continence for Peace of Mind. Since social standards are as they are, the individual will be both consciously and unconsciously influenced to conform to them; and the social impulse speaks as loudly as the sex impulse. Also, the superego, his best self—the product of the individual's upbringing at the hands of parents and other early guides—sets for him certain standards of an ethical and esthetic nature.

When a conflict arises regarding the gratification of sex outside marriage, many a person realizes quite well that he could not stifle the impulses that come to him through social standards and from his superego. He knows that having developed a high standard one is virtually compelled to live up to it or to suffer misery. What often arises is loss of self-respect for lack of self-control, or for disappointing or harming others, or for yielding to the purely sensual in violation of higher standards of love. One may react in disgust with one's self against a relationship that lacks the romance and idealism and altruism of love.

For one reason or another it appears that inner turmoil often is the chief result of love affairs outside marriage, and many people, realizing that fact, choose deliberately to deny sex until its expression has the approval of their whole nature.

Emotional Fixations

What Is Autoerotism? At the time in adolescence when the sex impulse becomes strong, or indeed at any time in life, a habit may recur which is first manifested in infancy—that of masturbation. It is a purely sensory gratification, and in the infant has not the same sexual significance as in the adult. It appears to occur in the infant as a part of its general interest and curiosity about its own newly discovered body. It finds that it has fingers and toes and enjoys playing with them; it takes a similar

interest in the genital organs. Unless attention is unduly focused upon the habit, it is usually abandoned as the child becomes interested in its surroundings and ceases to be narrowly interested in itself. Later, the habit may be resumed as a means of sensory gratification.

At no time in life is masturbation as physically harmful as is popularly supposed. Nor is it the cause of mental disease, nor the result of it. But it may be somewhat harmful to the development of the personality. The term autoerotism means self-love. Often those who are the most seriously addicted to masturbation exhibit self-love in a number of ways: they are likely to be self-centered and self-indulgent, and to find the greater part of their satisfactions, both sexual and otherwise, in themselves. The mythical Narcissus who admired his own reflection in a fountain is the prototype of the autoerotic personality.

Obviously, the personality at the infantile level of development will be hampered in a world of adults and should take the next step, just as the normal baby does—that of widening its interest. Although masturbation may occur in those of other types, it seldom becomes tenacious except in those of the type mentioned. In any case, it represents a departure from the adult level of emotional interest, and should be abandoned in order to open the path to full development. The methods of breaking the habit are the same as those to be mentioned for the general control of the sex impulse.

What Is Homosexuality? At the time in babyhood when the interests normally tend to widen, they are at first centered in others nearby. Then comes a period when the interests are chiefly in those of the same age, whether male or female. Shortly, however, boys begin to flock with boys and girls with girls. This childhood level of interest in the same sex is called the homosexual level. It implies nothing of sexuality in the adult sense, but merely a center of interest emotionally. Often it persists until puberty or after, the members of each sex usually much preferring as companions those of their own sex.

When the time arrives when a person tends to fall in love, if he is still at the homosexual level of interest, he may become intensely attached emotionally to someone of the same sex. This is particularly likely in those of strong affections. Such attachments among girls are called "crushes," but they occur often among boys. They are characterized by a marked dependence upon the object of the affection, and a degree of jealousy that makes these affairs on the whole apparently the cause of more misery than happiness.

Ordinarily there is little or no sexuality in "crushes," yet they seem to have some importance as a mode of sex expression. Homosexuality, like autoerotism, is of significance chiefly because it may sometimes be relied upon to solve sex problems. It should be strongly emphasized that it does not offer any adequate solution. For those who have not yet reached the adult heterosexual (man and woman) level of interest, intensely emotional attachments to those of the same sex may check normal development. For those who have reached that level, a reversion to a previous level of interest is an evasion rather than a solving of problems of sex; progress involves moving forward and the meeting of adult problems on an adult level.

It need hardly be mentioned that the sort of overemotional attachment under discussion is to be distinguished from friendships between those of the same sex. Friendship has nothing in common with the violent "crush" characteristic of the homosexual level. One of the finest manifestations of full adult development is the ability to give and to receive close and loyal friendship; and that sort of friendship is indeed of major importance in the solution of many of life's conflicts, including those of sex.

Immature Attitudes toward Sex May Persist. Instead of being attracted by the opposite sex, some individuals at adolescence are repelled. Perhaps the most pronounced "man-haters" and "woman-haters" occur among boys and girls in the 'teens. Often this is due to an unconscious effort to combat the newly developed emotional interests in the opposite sex. These interests, scarcely appreciated as such, are felt to be inimical to peace of mind, and are repressed for self-protection against further disturbance. It often happens, however, that the one who most completely rejects all interest in the opposite sex may swing as far in the other direction when he or she finally ceases to create an artificial lack of interest, and may fall violently in love with the first member of the opposite sex to break down the defence mechanism.

Failure to develop a mature attitude toward the opposite sex apparently occurs sometimes because the individual has been environmentally situated so that opportunities have been unfavorable for the normal extension of interest; sometimes because of early unfortunate experiences showing the opposite sex in an unfavorable light (e.g., discord between parents); but most often it represents a triumph of the safety motive, which seeks to keep one safe and secure in the familiar role of childhood rather than insecure and therefore possibly unhappy in the role of an adult.

Often an attempt is made forcibly to crowd sex out of the mind, to refuse it any consideration. Sex is a reality which must be faced, like all other realities. It should be frankly admitted that sex is a major force in life, and a valuable one. It is of value primarily as a means of procreation, but also it is of value to individuals. Most of the greatest satisfactions of life come about through the exercise of the sex functions —in love for the mate and in bearing and rearing children. Sex is not low and unworthy except when it is made so by a low and unworthy person. There is nothing higher than the mating relationship, and all that it implies, when it is on the high level of high-minded persons.

Dealing with Sex Impulses

How Are Sex Conflicts Solved? As has been suggested, conflicts arise between the sex impulse and the ego and the societal impulses. Most individuals solve these conflicts by bringing in a fourth combatant—the intellect. With its faculties of discrimination and judgment the intellect surveys all the other wishes and the various possible courses of action, and usually it allies itself with the social impulse and the superego, or better self, in opposition to sex expression outside marriage.

The next step is for the intellect to find a method whereby its conclusion can be acted upon and sex be kept under control. Intelligent and discriminating persons usually find that the methods suggested in the following sections are of use in such control.

The Question of Caresses. Caresses are biologically the preliminary steps toward mating, and logically lead up to it. Any form of personal contact may or may not be caresses, according as they do or do not spring from sex or arouse it. Young people often maintain that a kiss is "nothing," and to be sure it may be nothing for one of the two—but if it is in any way sensual to either, it is a caress and not a formality.

Since caresses have one biologic purpose—that of arousing sex—it should not be a matter of surprise that they often do precisely that, very promptly and to the ultimate degree. That the border is so narrow between what is intended and what is emphatically not intended may not be recognized, especially by girls, whose emotions are usually, with respect to sex, less easily aroused than are those of men. Quite without any anticipation of such excitation, an individual may suddenly be overcome by it—unable, and indeed no longer wishing, to turn back. It does not do to take too much emotional security for granted in one's self or in others.

Apart from the strain that petting places upon emotional control, it should be mentioned that it may be a strain on the nervous system and the reproductive organs if sex relations are too often approached and then denied. The possibility of infection through promiscuous petting has been mentioned elsewhere.

Value of Social Conventions. The social conventions of former times that restricted the association of young men and women were perhaps based upon too much fear, which magnified the biologic and social dangers. On the other hand, the widespread lack of conventions today is certainly based upon bravado, which minimizes those dangers. Often the bravado is based upon naiveté due to lack of knowledge of human nature; more often, upon an equally naive belief that any difficult situations that might arise could be easily controlled.

It is not the mark of a suspicious or timid mind, but of an enlightened one, to recognize and forestall situations that invite intimacies. Without being at all fanatical about it, it is safer to keep out of harm's way. To be sure, avoidance of danger is a negative sort of protection, but all sorts must be used when, at best, self-mastery is none too easy.

To avoid having to make decisions anew on every occasion, it is desirable to establish a set of conventions to be used automatically as an aid to maintaining one's chosen line of conduct. Such conventions should be established on theoretical grounds, before unfortunate experiences have shown the need of them.

It should be noted that the conventions are valuable for the sake of conduct and also for the sake of reputation. The young woman is indeed naive who thinks that a suspicion of laxity regarding sex does not injure her reputation in the eyes of the very ones whose respect she would most like to have.

Alcohol Affects Sex Impulses. Indulgence in alcohol has two effects that complicate many social situations: the senses are more easily aroused, and at the same time judgment and control are weakened. Even after a small amount of alcohol has been taken, behavior that would not be contemplated at all under ordinary circumstances is likely to seem either harmless or perhaps desirable. Therefore those who seek to keep on an even keel in regard to sex would do well to forego alcoholic beverages themselves and to avoid association with those who because of alcohol are temporarily oversensual and underrestrained.

Use of Protective Social Technic. Having established a border beyond which one does not intend to cross, not approaching this border too

closely is largely a matter of skillful social technic. Every grown person should make it a matter of pride to be able to have pleasant association with those of the opposite sex and to keep it on the level he or she prefers. That ability is what constitutes a man or woman "of the world." It is that more than anything else which is implied in the term sophistication. The ability to stir up trouble is biologically inherent in male and female, and should not be taken to mean unusually captivating charms. Anyone can start trouble; not everyone can keep it from starting.

The correct technic does not include prudishness in manner nor any unpleasant behavior that will offend and repel those whose friendship is worth having. It will not lead to unpopularity: even young people, except those who are sensuous and selfish, will not think less of another person who excludes sexuality from friendship and makes a point of putting agreeable companionship in its place.

Is Substitution Useful in Sex Conflicts? In many normal young people the great force represented by the sex instinct does not cause any particular difficulty because they learn quite naturally how to direct it and control it in ways that are approved by the intellect. This is especially true in the case of those who have learned to look squarely at all sorts of problems, not shying away from facts. It is also true in the case of those who have learned to restrain various other impulses, for the good of themselves or of those about them, and have not become accustomed to having all their desires immediately gratified. This kind of training, even though begun late, gives much assistance in the training of the sex impulses.

When giving up one desire, the natural thing is to put another in its place. It is a matter of common observation that one can usually substitute one goal for another without any great loss of euphoria. Many do this unconsciously, and in lieu of unacceptable sex interests find many other interests and pleasures with which to fill their time, engage their minds, and use their energies. The principle of substitution is that one cannot attend to two interests at once, either inevitability or expediency being the criterion in choosing which shall be given attention.

Sublimation of the Sex Impulse. Although simple substitution may serve to divert attention from sex, sublimation offers the only entirely satisfactory means of coping with the sex instinct under circumstances when the intellect directs that it should not be used in native ways.

Sublimation involves not merely expediency, but the symbolic gratification of a wish on a level that is personally and socially more ac-

ceptable at the time and under the circumstances. All the energy of the primary wish is utilized, but in the pursuit of the symbolic, rather than the primary, goal.

Sublimation often takes place more or less automatically, the individual not being fully aware of sex impulses nor of the methods whereby he sublimates them. More often, sublimation occurs as a result of the individual's finding out for himself that merely keeping himself occupied and casually interested in other matters is not enough, but that he must adjust in more fundamental ways to his impulses. Frequently, much thought is necessary to the establishment of an adequate sublimation and to its subsequent maintenance.

Sublimation usually takes place along several lines.

First, the love aspects of sex may be symbolized in other kinds of love. It is possible to sublimate the most intense love for an individual, for love is not love unless it extends far beyond sex. Even in the marriage relationship the instinctive is for the most part submerged by the idealistic. The sublimation of love is indeed its greatest glory.

Love for persons other than the beloved may also be part of the irradiation of sexual love; for example, love for old persons, for children, and for the unfortunate.

For complete sublimation it is often necessary to open one's heart to the whole world and to love all mankind. Many of the happiest and most successful people realize quite well that humanity is receiving the devotion that in other circumstances might have had one person as its object. And the love of one person may still be the flame that illumines life, even though that love has been denied all but sublimated expression.

Second, the creative aspects of sex may be symbolized by creative work, the "child" of one's brain or hands. The wish for achievement is an ego wish, but it may be rather definitely symbolic of sex wishes in that it, too, involves creation. Work which is undertaken as sublimation must be such as to involve the use of one's best efforts and be truly representative of one's best self. But it may be any kind of work. It is not only that sort commonly known as creative work—art, music, literature, invention, and the like—that can be representative of one's self. Any work done with the force of the whole personality and powers behind it is creative work and offers a channel for what might otherwise be the dangerously pent up, or perhaps inadequately pent up, force of sex.

Third, the social aspects of sex, normally expressed through fulfillment

of the social need for perpetuation of human kind, may be symbolized by another sort of tribute to human welfare. The fullest sublimation will look not only to the self and its personal relationships and its accomplishments as such, nor even to mere social acceptability, but also will look to social value. It will mean being of use in the world—a principle that is psychologically as sound now as it has long been ethically sound. It is interesting to note that traditional ethics and the most modern psychologic principles so often arrive at the same point.

To summarize: those who have many interests in common with many people and care much for others, on a nonmating basis whenever and for as long as it is necessary, who put all of themselves into whatever they do and get pleasure from both work and play, and who try to be of service to others and to the situations in which they find themselves, should not be unduly disturbed by sex emotions. They will wish for life in all its variety, but will miss nothing of the fullness of life, even though some of its experiences are denied them.

Part 5

The Next Generation

19
Reproduction

To reproduce its kind is characteristic of all living things. The simpler the organism, the simpler the process of reproduction, and the less significant is the parent-offspring relationship. In fact, among the lowest forms of life (e.g., bacteria) the single cell simply divides into two, its individual life ceasing when its offspring come into being.

In human beings there is an elaborate system of reproductive organs which not only perform the function of reproduction but also influence the individual life, physical and mental, in many important ways. Notably, the matter of parenthood is taken seriously, to be fulfilled as a personal and social responsibility toward the offspring in all the many ways within the range of human powers.

The Reproductive Function

Essential Reproductive Organs. In both sexes, the essential organs of reproduction are the gonads, or glandular structures that produce the sex cells, and the tubes through which these cells pass on their way toward union. In the female there is also a sac to hold the child before birth. Other parts of the reproductive system, which will be mentioned in the next two sections, are accessory to these.

The reproductive organs are formed before birth, and they continue to develop during childhood, but do not attain full development or functioning ability until puberty.

Sexual Maturity. Puberty is the beginning of adolescence (becoming adult). It occurs from 11 to 16 years of age, according to the activity of the pituitary gland, the gonads, and certain other endocrine glands. Usually it occurs slightly later in the male than in the female. Puberty that occurs too early or too late may have medical significance.

At puberty the essential change is that the sex glands take up their

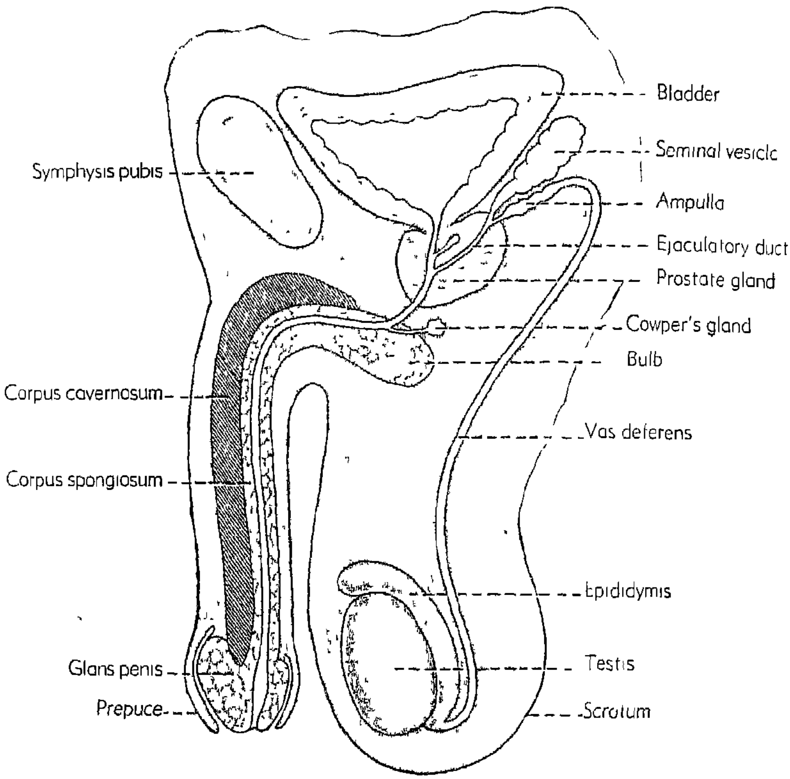


Diagram of the reproductive organs of the male.

function of producing sex cells that are capable of reproduction. Although parenthood is possible in most cases at any time after puberty begins, it is not physiologically suitable until adolescence is practically complete.

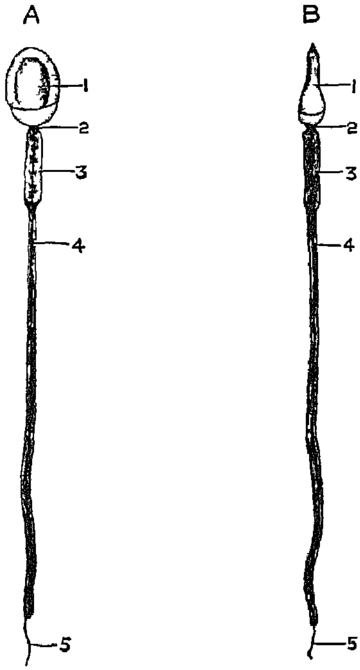
The characteristics that differentiate the adult from the child, and the adult male from the adult female, are the result of changes occurring in the gonad secretions at puberty. In both sexes, physical and mental changes appear as evidence of maturity.

In the male the voice deepens, hair appears on the face and body, the body becomes more angular and muscular, and the function of emission begins. In the female the pelvis widens, the subcutaneous fat becomes more abundant, especially about the breasts and hips, the mammary gland tissue increases in amount, hair appears about the external genitals and under the arms, and menstruation begins.

In both sexes an interest in the opposite sex appears, usually in later adolescence if not at puberty. This may be merely on the plane of companionship, or of intellectual interest, or it may be a tendency to fall in love. Impulses that are definitely sexual may or may not develop during adolescence.

The period of adolescence lasts until 18 to 20 years of age. It is characterized by the final attainment of sexual maturity and normally of fitness for parenthood.

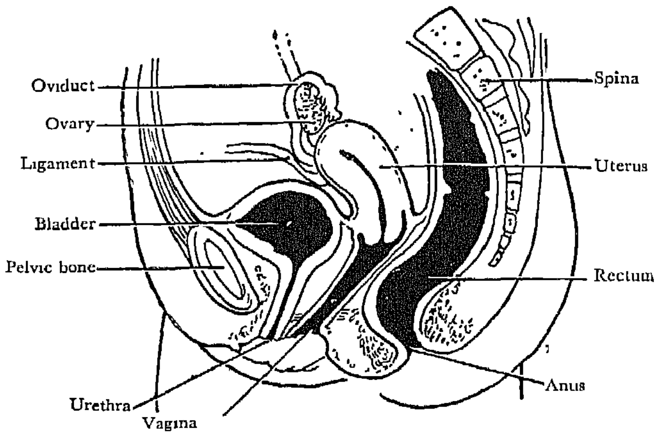
The duration of the functioning sex life is until 45 or 50 years of age in the female and usually until old age in the male. Its cessation in the female is called the climacteric or menopause. The chief changes in the female at that time are loss of reproductive power and the absence of the associated function of menstruation with, in some cases, waning of the sex impulse, and certain symptoms indicative of the general change in endocrine gland function. In the male the conclusion of the reproductive life is gradual and usually not definite.



Semi-diagrammatic representation of human spermatozoa. (A) Front view. (B) Side view. (1) Acrosome, surrounding head. (2) Neck. (3) Middle-piece. (4) Tail. (5) End-piece. The axial filament runs through the body and tail into the end-piece.

Male Reproductive Functions. In the male, the sex cells are called sperm cells or spermatozoa. They are very small cells, long and narrow in shape, usually long-lived, and possessing the power of propelling themselves by means of a whip-like motion. They are produced in prodigious numbers in the testes (male gonads) which are located in a pouch of skin and muscle, called the scrotum, suspended from the lower part of the pelvis. On p. 402 are shown the tubular structure of the testes, and the larger tubes with which these unite, through which spermatozoa are ultimately discharged from the body.

The sperm cells are carried in a fluid (semen, or seminal fluid), to which is added the secretion from the prostate and from other glands



Median section of female reproductive tract.

which empty into the vas deferens as it winds through the pelvis. Spermatozoa and semen are constantly being produced and stored in the seminal vesicles.

The seminal fluid leaves the body by means of the urethra, the tube leading outward from the bladder. This tube passes down through the penis, an organ which contains muscle tissue and also many blood vessels that are capable of being greatly engorged. When distended thus, the penis becomes larger and firmer for its introduction into the female during coitus, to place spermatozoa in a location from which they can travel to meet an ovum. Because it becomes more erect when it is thus engorged, the process is known as erection. (Although erection is for the physiologic purpose mentioned, it takes place at times under other circumstances, either as a result of local stimulation such as that produced by the accumulation of semen in the seminal vesicles, or as a result of psychic stimulation by erotic thoughts and emotions.)

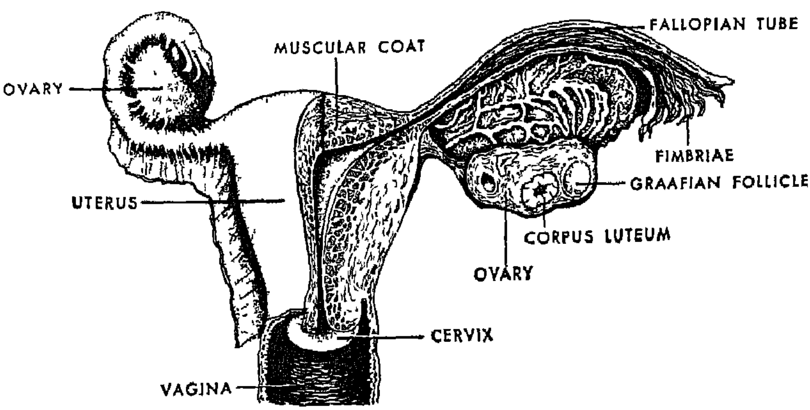
Female Reproductive Functions. Whereas the male takes part in reproduction simply by furnishing spermatozoa, the female has functions that are much more elaborate. The reproductive organs of the female are: the ovaries (female gonads) located one on each side of the pelvic cavity; the uterus (a muscular sac, about the size and shape of a pear, located in the middle of the pelvis); the oviducts (two tubes, one of which extends from each upper corner of the uterus toward the ovary); the vagina, a muscular tube from the lower part of the uterus downward to the surface of the body (its opening is between the urethra and the anus, and in the virgin is partly closed by a membrane called the hymen).

Through the vagina the menstrual flow is discharged, spermatozoa are received, and childbirth occurs.

In order for reproduction to take place the ovaries must perform the function of ovulation. This consists of the maturing of an ovum (usually only one) every 28 days, and its extrusion from the ovary. Each ovary contains many ova, each enclosed in a small sac (Graafian follicle). As an ovum begins to mature, the fluid in its sac increases, so that the sac swells, until ultimately its periphery touches the periphery of the ovary. With further distention of the sac, its covering, and also the covering of the ovary at that spot, ruptures. The ovum passes out into the abdominal cavity, but is soon taken up by the fringed end of the oviduct. The lining of the oviduct is ciliated mucous membrane (i.e. the mucous surface has fine hairlike projections that wave back and forth). Since the strongest motion of the cilia in the oviduct is toward the uterus, the ovum is slowly moved along in that direction. During its passage it concludes its process of maturing, and is ready for fertilization by the time it reaches the middle of the tube.

Fertilization of the ovum takes place when the mature ovum in the oviduct is met by a sperm cell, which unites with it. The seminal fluid has previously been deposited in the vagina, in the act of coitus or sexual intercourse, and the sperm cells have traveled upward through the uterus and out into the tubes. When one of them encounters an ovum, it unites with it so that the two make one cell (the fertilized ovum, or the zygote) from which the new being will develop; conception has taken place.

From the point in the oviduct where conception takes place, the fer-



Female organs, showing vertical section.

tilized ovum continues to travel toward the uterus, and very shortly its implantation into the lining membrance of the uterus occurs.

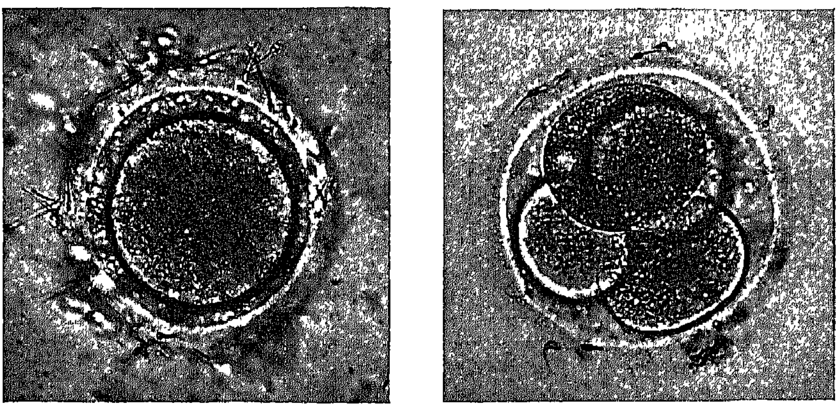
Gestation or pregnancy begins with fertilization or conception, and continues for nine calendar, or 10 lunar, months.

Intrauterine Growth of the Embryo. Growth before birth is more rapid than at any later period of life. As soon as the zygote is implanted it divides into two parts, each of these divides into two, and so on, until they form the millions of cells that make up the newborn child.

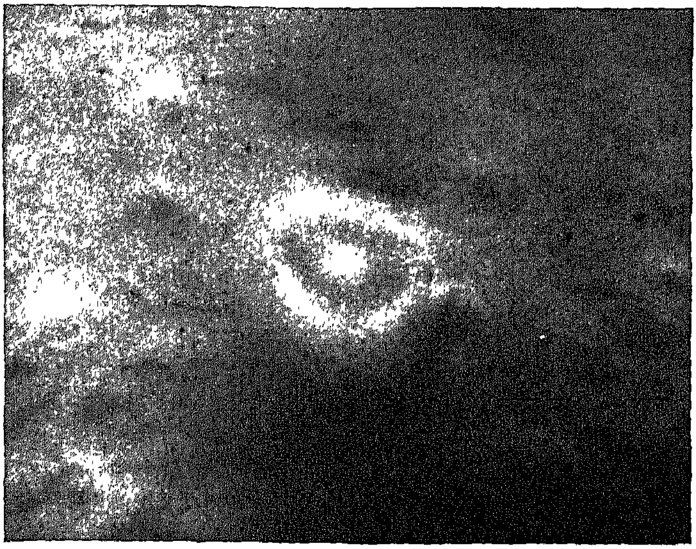
The cells not only divide but become differentiated into all the various varieties forming the human body. Also, they arrange themselves in orderly fashion, so as to form each part and organ. In about four months the embryo has distinguishable eyes, ears, fingers and toes and its sex is apparent. Shortly after that, its heart beat can be heard through the stethoscope.

Quite early, a membrane called the amniotic sac forms around the embryo, enclosing it entirely. In the sac is a fluid in which the embryo floats. It acts as a hydraulic cushion to protect the embryo from too sudden or severe changes of pressure from without.

How Is the Embryo Nourished? All living things require nourishment, and this is true of the fertilized ovum from the moment of conception onward. At first it derives its nourishment directly from the blood vessels in the uterine membrane upon which it rests. Later, the embryo develops blood vessels of its own and an elaborate system for the transfer of nutri-

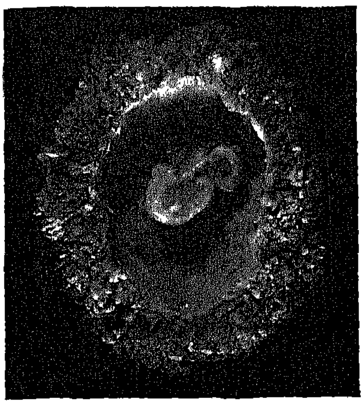


(*Left*) Zero hour. Ovum of rhesus monkey. Sperm have reached but have not penetrated the membrane. (*Right*) First stages in cell division. (Courtesy, Chester F. Reather, of the Baltimore Embryological Laboratories of the Carnegie Institution, and *Science Illustrated*.)



Implantation. Human blastocyst seven days beyond fertilization has just planted itself in the uterine lining. (Courtesy, Chester F. Reather, of the Baltimore Embryological Laboratories of the Carnegie Institution, and *Science Illustrated.*)

ment from mother to child and of cellular waste from child to mother. The blood vessels of the child connect with large vessels that form a cord (umbilical, or navel cord), extending outward from the center of its



(*Left*) Within the chorion. Twenty-eight-day embryo with chorionic sac cut open. (*Right*) Human embryo at end of fifth week seen through transparent amniotic sac. (Courtesy, Chester F. Reather, of the Baltimore Embryological Laboratories of the Carnegie Institution, and *Science Illustrated.*)

abdomen. This cord is attached at the other end to the placenta, a disk-like structure composed of blood vessels, which is attached to the wall of the uterus. The blood vessels in the placenta intermingle with those of the mother in the wall of the uterus.

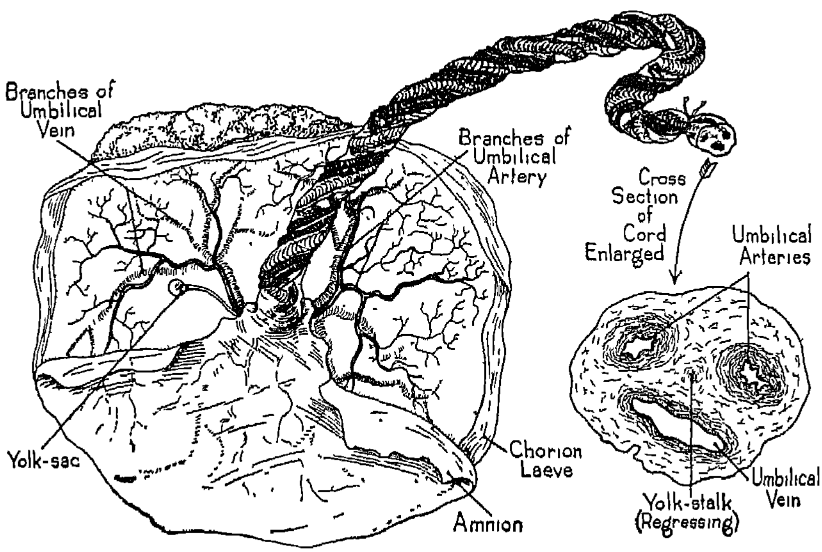
The child's nutrition depends entirely upon the mother's diet, the maternal blood must contain all that its growing cells need.

Birth. Delivery or birth of the child usually takes place spontaneously when prenatal life is complete.

During pregnancy the uterus increases enormously in size, and its muscle cells increase in number, so that it is capable of great contracting power, which it uses to expel the child at the time of birth. It is aided by voluntary contractions of the abdominal muscles. At the time of birth, the amniotic membrane ruptures, discharging the fluid, which flows outward and is of assistance in easing delivery. The child passes through the vagina, usually head foremost.

The term labor is applied to the intermittent, regular contractions of the uterus which result in delivery of the child. The process usually lasts from two to 10 hours, with labor pains first occurring at wide intervals and later becoming stronger and more frequent.

For a short time after the birth of the child the placenta remains attached to the uterus. The child is separated from it by clamping and

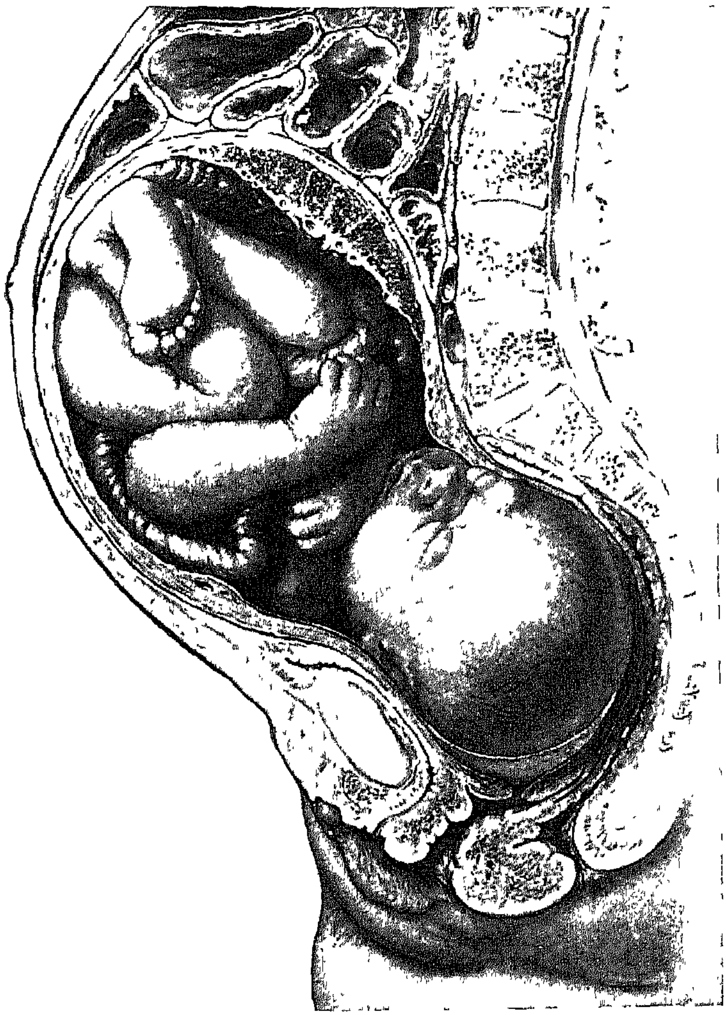


Placenta and umbilical cord at term. (*Left*) Fetal face of placenta. (After Corning.) (*Right*) Cross section of umbilical cord.

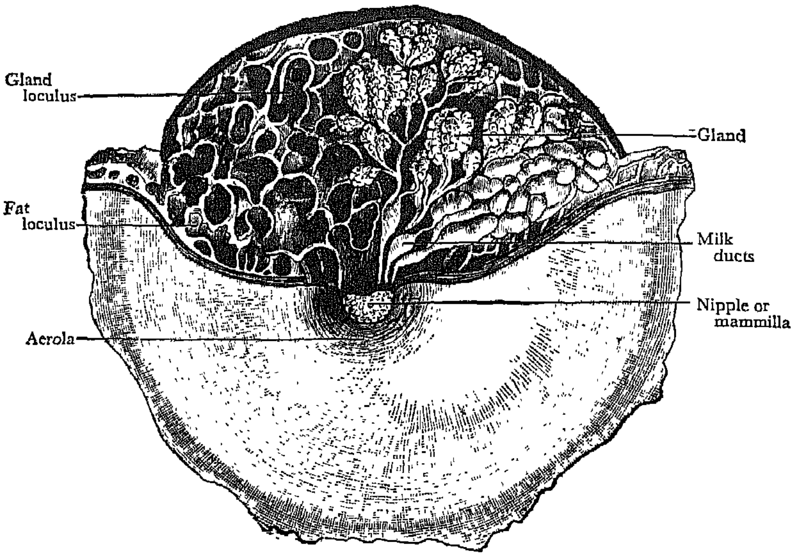
cutting the navel cord near to the abdomen. Its healing forms the dimpled scar known as the navel.

The remainder of the navel cord and the placenta and membranes are delivered within a few minutes. These structures are then called the "afterbirth."

Although the process of birth is natural and often easy, expert assistance is always an advantage and sometimes absolutely essential for the life of mother or child or both.



Full-term fetus in utero. Drawn by Max Brodel. (Used by permission of A. F. Nystrom & Co., Chicago, publishers of life-size anatomical charts.)



Mammary gland, showing enlarged milk ducts during lactation.

Nourishing the Newborn Child. During pregnancy, endocrine secretions cause the mammary glands (breasts) to increase in size and their lacteal gland tissue to become ready to secrete the milk which is the natural food for the infant. Lactation commences soon after the child is born. Occasionally the mammary glands do not function properly, but it is believed that proper care, plus a strong enough desire to do so, would nearly always make it possible for a mother to nurse her child. Breast feeding of babies is natural and except where advised against by a medical authority, the best method of nourishing the newborn child.

Why Does Conception Sometimes Fail to Occur? Conception fails to take place from the following causes: (1) no germ cells are produced in one or the other of the partners, either because of immaturity or disease of the sex glands; (2) cells are produced that are short-lived; (3) there is a barrier somewhere along the route the cell must travel in either one partner or the other, which keeps it from reaching the other germ cell; (4) the secretions of either the male or the female tract are chemically unfavorable to the life of the germ cells; (5) the uterus is in a position that is unfavorable for the entrance of semen; (6) the mucous membrane lining the uterus is not a favorable resting place for the fertilized ovum, which is cast off; (7) there is no ovum in the tube at the time the spermatozoa arrive and none enters the tube shortly thereafter, during

the brief lifetime of the spermatozoa—that is, ovulation has not occurred within a few days and is not about to occur; (8) medical measures, either mechanical or chemical, have been used to keep the ovum from union with a living spermatozoon.

Points (1) to (6) represent abnormalities; (7) represents the law of chance; (8) represents the avoiding of natural consequences. In regard to the latter point, it should be stated that such measures are sometimes necessary when pregnancy would be a danger, and that physicians are the ones to make the decision regarding the measures to be used. Unless so prescribed, they are likely to be unsafe or unsuccessful, or both.

Sterility is undoubtedly more often due to the results of venereal disease than to any other single abnormality. In either sex, a common abnormality that results therefrom and that causes sterility is the sealing of the ducts through which the germ cells should pass. This takes place as a result either of swelling caused by inflammation, or the healing of inflammation with the formation of scar tissue which has contracted.

Twins or Multiple Births. In some cases two ova, one from each ovary, mature and are fertilized at the same time, and continue their development together. This produces twins that are heterologous or unlike (except as brothers and sisters often resemble each other). Such twins are called fraternal. In other cases, each of the first two cells formed by the first division of the zygote goes on to separate development instead of remaining together and forming one individual. Such twins are identical in sex and in all hereditary characteristics, and they will be precisely alike except as a result of what happens to them as they develop before or after birth. They are identical, homologous or single-ovum twins.

The tendency to multiple conception is hereditary. It may give rise to as many as five children at a birth.

Associated Functions

In each sex during the reproductive period of life the sex organs manifest their activity by a recurring function—emission in the male, and menstruation in the female.

Emission

What Is Emission? After puberty, sex cells are constantly being produced in the tubules of the testes and stored in the seminal vesicles. In the absence of marital relations, the seminal vesicles become over-

distended at times, and they discharge automatically. Since this process occurs during sleep it is called nocturnal emission. Sensory impulses from the erection and ejaculation may be vaguely or clearly experienced, often as part of a dream.

The frequency of emission varies according to the rate at which the seminal vesicles become distended. It may occur normally several times a week or not at all. Its frequency decreases with age.

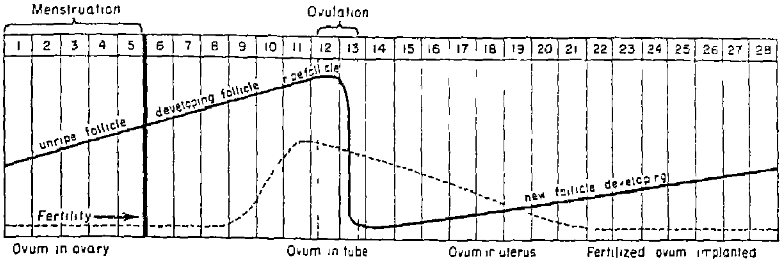
This normal and harmless function, which represents merely a passive overflow of accumulated secretion, is often represented by quack "doctors" as a great danger. They speak of "lost manhood," and even of serious diseases, as a possible result. Emission does not deprive the body of any substance it needs or can use, and does not weaken. Nevertheless, if it occurs too frequently, a reputable physician should be consulted.

Are Other Discharges Normal? It is not normal to have any sort of discharge from the urethra except at micturition and ejaculation, and at micturition the urinary fluid should be clear and should be passed without pain or smarting. Any departure from normal should be investigated, whether or not there has been any known exposure to venereal disease. Similarly, any soreness or swelling of any part of the genital organs should be investigated. There are several fairly common ailments that are insignificant at the start, but that should be cured before they progress.

Menstruation

Nature of Menstruation. Just before an ovum is due to reach the uterus, the mucous membrane which lines the uterus becomes congested and thickened. This is for the purpose of providing a suitable location for a fertilized ovum to implant itself, be nourished, and grow. If the ovum is not fertilized, it does not implant itself, but passes out of the uterus; the congestion of the uterine membranes, no longer having any purpose, subsides and a variable amount of oozing occurs from the over-distended capillaries. This continues for three to five days, and is called menstruation. If the ovum is fertilized, menstruation does not usually occur again until after the delivery of the child, or indeed until after lactation has concluded.

Menstruation Should Be Regular. Normally, menstruation occurs every 28 days (from the first day of one period to the first day of the next), lasts from one to six days (usually three or four), causes a moderate flow of blood, and is not accompanied by pain.



Relationship of menstruation, ovulation, and fertility.

Absolute conformity to any given standard in respect to frequency, duration and amount of flowing is not essential for health and, in fact, is rather rare. If periods occur too often, last too long or are too profuse, the cause should be sought and corrected, because such conditions may produce anemia.

Ordinarily it is of little significance if the flow is scanty in amount and of short duration, or the interval longer than 28 days. This is the case in some of the most vigorous women. If the periods habitually occur at long intervals, however, it would be well to find out whether any abnormality is responsible for it—as, for example, a disorder in the endocrine glands. Absence of menstruation for the first few months of college life is not at all unusual, even in healthy young women. On the other hand, if accompanied by any symptoms of ill health, loss of weight or fatigue, it should be investigated. Occasionally, cessation of menstruation occurs at the onset of tuberculosis.

There need not be and should not be any self-prescribed treatment to bring on a delayed period. The same is true in regard to efforts to delay or to stop a period. All such efforts are either futile or harmful.

Should Menstruation Cause Pain? There should be no pain or disability from menstruation. It is as normal a function as digestion, and should be as easy. If pain (dysmenorrhea) occurs, it should not be accepted as inevitable without making an effort to find out the cause and to correct it.

The cause of menstrual pain may be an endocrine disturbance, often correctible by the use of endocrine gland extracts; or congestion of the pelvic organs, often correctible by improvements in physical or mental hygiene.

Among the measures of hygiene that are most likely to be of assistance are: (1) improvement of posture, so that downward pressure of abdominal organs on pelvic organs will be at the minimum; (2) correction of

constipation, again to limit downward pressure upon the uterus and ovaries; (3) avoidance of tight clothing around the waist that would cause downward pressure; (4) enough bodily activity to keep the general circulation active; (5) exercises involving the lower part of the trunk and the hips for their local effect in activating pelvic circulation; (6) avoidance of sex-stimulating caresses and phantasy; and (7) a diet affording all nutritive essentials.

It would seem illogical to allow pain to occur and then try to relieve it by such measures as staying in bed, applying heat, taking hot drinks, or taking pain-relieving medicines. The latter may indeed be unsafe; many of the popular medicines for dysmenorrhea contain aminopyrine or other drugs highly dangerous for self-treatment, as was mentioned on page 227.

More rarely, menstrual pain is due to a condition not correctible except by surgical treatment of uterus, tubes or ovaries. Occasionally, it is related to inflammation of the appendix.

Leukorrhea. This term is applied to a white or whitish discharge from the vagina. It may occur without symptoms and be more or less chronic, or it may come on suddenly with itching, burning and pain on micturition. The cause is likely to be infection, but the chronic variety may be due to pelvic congestion.

Leukorrhea should always be investigated. Usually it can be cured, although not by self-prescribed douches and the like. Such a discharge may be due to gonorrhea, but there are many other organisms that cause similar symptoms. Any infection of the vagina should be checked before it invades the other parts of the reproductive system.

Hygiene of Menstruation. The hygiene of menstruation involves no great departure from the usual habits, provided those habits are good. Warm tub or shower baths may, and should, be taken as usual. Even cold baths may be taken if one is thoroughly accustomed to taking them and reacts well to them. But in connection with bathing and any other activities, the usual precautions against chilling should be still more carefully observed. To become chilled might possibly cause pelvic inflammation, with derangement of the functions of the reproductive organs. Exercise also may be taken as usual, with care not to become overfatigued. Because of the additional weight of the uterus at the onset of a menstrual period, and the possibility of stretching its supporting ligaments, exercise that involves jumping and jouncing should be avoided (e.g., tennis, horseback riding, basketball).

20
Heredity and Parental Care

Heredity

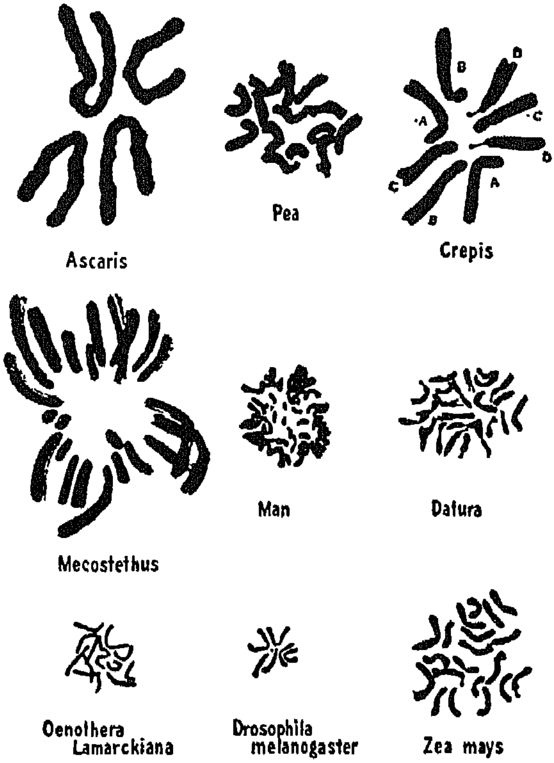
Genes

What Determines the Inheritance? Without going into the intricate details of heredity it may be stated briefly that the inheritance of all characteristics or traits is determined by small particles called genes, contained in larger bodies called chromosomes, which occur in pairs in the nucleus of each cell. For example, a muscle cell becomes a typical muscle cell because its nucleus contains genes which determine the characteristic traits of a muscle cell. Similarly, an eye becomes brown rather than blue because cells of the organism contain genes for brown color.

When reproduction occurs by simple division of a cell into two, as is the case with most bacteria, the cell divides into halves, and so does the nucleus. Each chromosome also divides longitudinally and each new cell receives an identical set of chromosomes with their contained genes. There are two genes for each characteristic, such as eye color for example. Each of the two new cells will thus be exactly like the parent cell in inheritance. However when eggs and sperm are formed at one division of the cell from which they are formed, the chromosomes do not divide. Instead, one of each pair of chromosomes goes into the new cells which will become eggs or sperm. Each of the two new cells thus contains one set of genes exactly the same as the parent cell.

When reproduction occurs by the fusion of two cells, an egg and a sperm, the fertilized ovum contains one of each pair of chromosomes, with one set of genes, from each parent. The offspring thus receives an assortment of genes unlike .that of either parent. Its characteristics will depend upon the number and kind of genes.

Dominant and Recessive Traits. Mendel, an Austrian monk, in 1865 first presented his studies on the inheritance of characteristics. He found that certain traits are dominant, which means that the trait will always appear if there is one gene present for that trait. Other traits are recessive, which means that they do not appear unless two genes for them are



Chromosome groups of nine animal and plant species, all drawn on the same scale. (After Morgan.)

present. For example, the trait "black fur" is dominant in the rabbit and the trait albino is recessive. On p. 417 the dominant trait is indicated by D and the recessive trait by r.

What Is the Mendelian Ratio? On p. 417, it will be noted that the parents (P) were each homozygous (containing two similar genes) with respect to hair color, one parent having two genes for the dominant trait, and the other having two genes for the recessive trait. In the first generation of offspring (F_1 first filial generation) all the offspring will have a gene for the dominant trait and will be gray, but each will carry a gene for the recessive trait which they may pass on to their offspring.

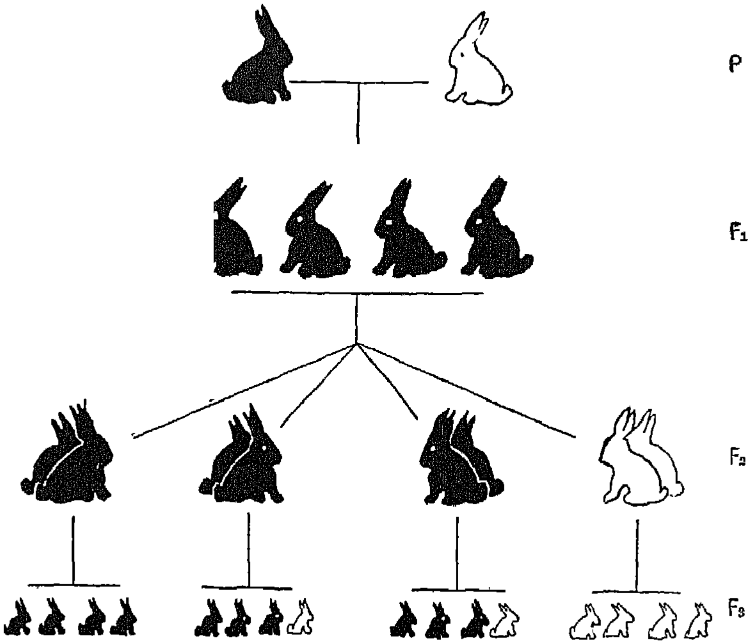
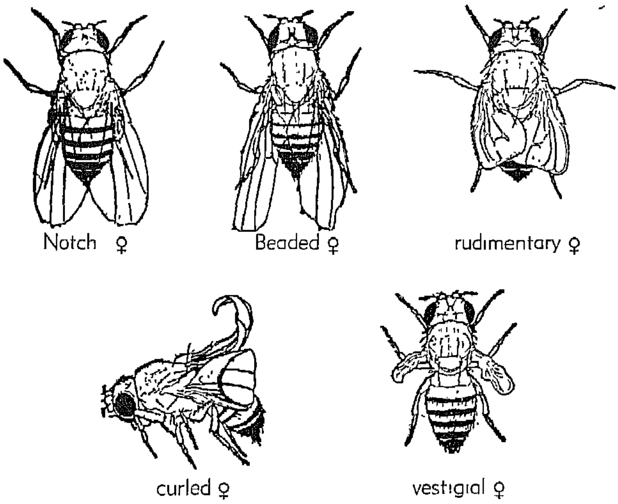


Diagram to illustrate Mendelian inheritance. (In each case after the first, each mating is with another of the same inheritance.) In (F_1), (F_2), and (F_3), how many black animals are pure black and how many white animals are pure white in their genetic constitution?

In the second generation (F_2), one fourth of the offspring will have two genes for the dominant trait; one-fourth will have two genes for the recessive trait; and one-half will have one gene for the dominant and one gene for the recessive trait. Since those with only one gene for the dominant trait will show that trait, three of these animals will be gray and one will be white. But since two of the three have a gene for the recessive trait, their offspring will show that trait if they inherit another gene for the recessive trait from the other parent.

Possible Crosses. There are only three types of genetic constitution with respect to a given trait, DD, Dr, and rr. And of these three there can be only six crosses, as follows:

DD x DD
DD x Dr
DD x rr
Dr x Dr
Dr x rr
rr x rr



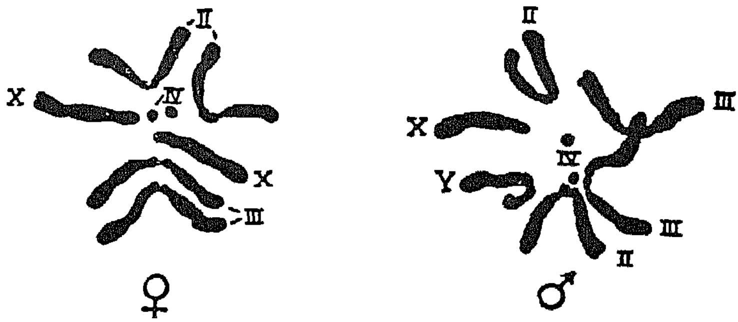
Certain Drosophila melanogaster mutations are manifested primarily as injuries to the normal structure of the wings. (Courtesy, T. H. Morgan, C. B. Bridges, and A. H. Sturtevant, "The Genetics of Drosophila," *Bibliographia Genetica,* vol. 2, The Hague, Netherlands, Martinus Nijhoff, 1925.) (*Top, center cut*) (Courtesy. T. H. Morgan, "The Physical Basis of Heredity," Philadelphia, J. B. Lippincott Co.)

Bearing in mind that the dominant trait appears when one gene for it is present, the student should be able to compute the results of these six crossings in the genetic constitution and the occurrence of the dominant and the recessive trait in offspring of the respective crosses.

Human Hereditary Traits

What Human Traits Are Dominant? Certain traits of appearance are dominant. For example, brown eyes are dominant over blue eyes, which are recessive. Normally pigmented skin is dominant over the recessive trait albinism. In respect to color of eyes, hair, and skin, however, and perhaps in respect to some other traits, blending may occur in persons having the genetic constitution Dr. Regarding details of features, certain traits, such as a special type of nose, lips, or facial form, appear to be dominant.

Several peculiarities of anatomical structure are dominant. Among these are: brachydactylism (fingers or toes lacking one bone each, hence shorter); polydactylism (too many fingers or toes); and syndactylism (webbed fingers or toes). One type of dwarfing, achondroplasia, with trunk of normal length and short arms and legs, is dominant.



Male and female chromosome groups of Drosophila. (After Morgan.)

Some of the defects of the organs of special sense, leading to deafness, deafmutism, and blindness, are hereditary and dominant. So also are certain defects of the skin, such as excessive sweating, and excessive thickness; of bones, such as abnormal fragility; of muscles, such as hereditary tremor and hereditary stiffness; of nerves, such as hereditary chorea, a chronic severe type of incoördination usually appearing in youth, and the "shaking palsy," paralysis agitans, appearing in advanced age.

In general, normality is dominant over abnormality. Except for some of the conditions mentioned above, there are few seriously handicapping conditions which appear when only one gene for them is present.

What Human Traits Are Recessive? Traits that may not be present in an individual, but which he may hand on to his offspring if he has a gene for the defect and marries a person with a gene for the same defect, include several that are serious.

Among them may be mentioned several types of mental deficiency; some types of epilepsy; diabetes; certain eye conditions which may lead to blindness; and certain nervous conditions which may lead to paralysis.

Some of the recessive traits are sex-linked, i.e., the gene for them is carried in the same chromosome that determines sex. Without going into detail, it may be stated that most often these traits are transmitted by a mother who does not have the defect herself, but only genes for it. Her female children will usually lack the defect and some of her male children will usually have it. But the female children will have a gene for the defect and may transmit it to their children. Color-blindness is a sex-linked trait, present in 20 times as many males as females. Other com-

mon sex-linked defects are one form of night blindness; baldness; and hemophilia, a tendency to bleed profusely.

Other Human Hereditary Traits. Traits not classifiable as dominant or recessive include the normal traits of blood groups (p. 58); longevity; twinning, a tendency to multiple conception; possibly extreme tallness; and left-handedness. Among defects in this class are: extra teeth; myopia, nearsightedness; migraine, "sick headache"; deafness of one type, otosclerosis; and harelip, in some cases.

In addition, it is generally believed that tendencies to the following conditions are hereditary: some types of psychosis; some types of personality disorder, especially the types often found in those who become criminals, hoboes, and chronic alcoholics, or who show general "oddity"; some types of heart disease; arteriosclerosis; high blood pressure; gout; obesity; allergic sensitivity; hernia; varicose veins; endocrine imbalance; possibly rheumatic tendencies; and premature senility.

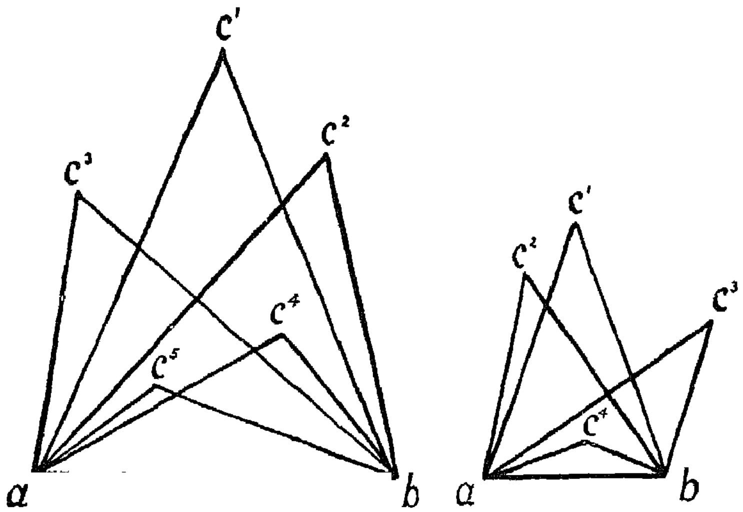
On the other hand, soundness of mind and body and the tendency to remain sound, also are hereditary, and these are generally thought to be dominant.

How an Individual Becomes What He Is. Presumably every characteristic of every living thing occurs on a substratum laid down by inheritance. Certainly the individual cannot become anything that his inheritance does not make possible. Traits superimposed upon inheritance are called acquired. A person cannot acquire a trait unless he "has it in him" to do so.

Certain hereditary traits appear regardless of what the individual does about it. Others do not inevitably appear. To take a simple example, a person may possess pigment cells in the skin enabling him to tan, but may never tan because he is never sufficiently exposed to the sun to develop this hereditary potentiality. The same is true of many important traits.

In some respects, hereditary potentialities are very wide, and in other respects sharply limited. An individual may conduct his life so as to cause his best hereditary potentialities to become actualities and so as to keep his worst hereditary potentialities at a minimum. Our social organizations, such as educational systems, exist largely to cause that to take place and to prevent the opposite from taking place.

The possibilities of personal development of a given trait are shown on p. 421. Using the base of a triangle to represent heredity in respect to that trait, and the two other lines to represent the two other great forces



Diagrams to show the effect of environment and training in relation to heredity. The base of each triangle (*ab*) is the inheritance. The other two sides of the triangles are to represent environment (*ac*) and training (*bc*). The area of the triangle represents the phenotype. Note that the area depends upon the length of *each* line.

that might influence it, environment and specific training, the total area of the triangle would represent the extent of development of the trait in question. The same schema may be used to represent inheritance as a whole, and the total development of the individual.

Familial Diseases. Diseases that "run in families" may be hereditary, but they should not be classed as such unless it is known that they are determined by genes. Familial diseases might be acquired, not inherited, in the case of each individual affected. First, contagion may account for many cases of the same disease in a family, the members transferring the germs to each other. This is the case, for example, with tuberculosis, formerly thought to be hereditary but now known to be acquired. Second, the same customs often prevail among those who live together, and if these are harmful, each member of the family may suffer from similar disorders. For example, indigestion runs in some families because the members have similar faulty eating habits. Third, similar faulty training may be passed on from generation to generation, with equally bad results in many members of a family. As an example, children brought up by nervous parents are likely to be nervous themselves and,

in turn, to bring up their own children in such a way as to make them nervous.

Should Inheritance Influence Marriage? For the sake of the partner, and especially of the offspring, consideration of inheritance will bar some persons from marriage. Before reaching such a conclusion regarding himself, however, a person should be certain that his fears regarding his inheritance are warranted. After having collected the necessary data about conditions that have appeared in his family, he should present them to his physician for an opinion. Most physicians have studied the science of heredity (genetics) to some extent, and know where to obtain additional information when needed.

Before a marriage occurs, an opinion should be obtained regarding the hereditary fitness of the two to marry each other. A basic rule is that if two persons have the same hereditary defect, or have genes for the same defect, and the defect is one that would be handicapping to their children—as, for example, blindness—they should not marry each other. If the trait were dominant and both had the defect, the parents would be either DD or Dr, and all their offspring would show the trait. If the defect were recessive—as, for example, feeblemindedness—and neither parent had the trait, both parents would be Dr, and 25 per cent of their children would have the defect.

However, some of the persons who should not marry other persons with the same defect or with genes for the same defect can safely marry persons unlike themselves in these respects. For example, a person himself normal but possessing genes for a recessive defect (Dr) can safely marry a person who is normal and has no genes for the defect (DD). None of their children will have the defect, although half of their children will have genes for it (DD, DD, Dr, Dr). Similarly, a person who has a defect and has only defective genes (rr) can safely marry a normal person lacking genes for the defect (DD). None of their children will have the defect, although all of them will have genes for it (Dr, Dr, Dr, Dr). Furthermore, if genetically suitable marriages occurred among all the descendants of these two types of marriages, the defect would not appear among them again.

Many traits are not simple Mendelian dominants or recessives, and accurate computation of the ratio in offspring cannot be made. In the case of poor traits, it is safest to assume that they are hereditary if they have appeared repeatedly in the family and if no acquired cause for them can be shown to have existed.

Parental Care

When marriage is planned, it is essential that the inheritance of each partner be considered and an expert opinion secured regarding the likelihood of their having hereditarily sound offspring.

Beyond that point, prospective parents have further grave responsibilities. As Dr. E. J. Kempf has said "The noblest and most difficult art of all is rearing human thoroughbreds."

What Is the Value of Premarital Examinations? Before marriage, each prospective mate should make certain, first, that he or she is free from communicable disease that could be passed on to the mate or child. In 14 states, this is required by law in respect to the venereal diseases; those applying for marriage licenses must present certificates of freedom from these diseases.

In the case of a woman about to marry, she should make sure that she has no other ailments that would prevent her from becoming the mother of healthy children. A number of conditions that do not permanently stand in the way of parenthood may do so temporarily, and will constitute a hazard for mother or child or both if pregnancy is begun before the abnormal condition is improved. This is true, for example, of malnutrition, some forms of heart disease, tuberculosis, diabetes, anemia, and various other common disorders.

Handicaps of Prenatal Life. The fact that the miracle of creation so often does bring into the world healthy specimens of humanity should be set over against the fact that in many cases the embryo fails to develop beyond the first few weeks or months of prenatal life. Or it reaches full term but dies before birth, or the child is born alive but defective and doomed to early death.

It has been estimated that the total number of spontaneous abortions and miscarriages is one-third the number of live births and that the number of stillbirths (infants born at full term but not living) is about 5 per cent of live births. Such failure of development may be due to preventable disorders of the mother's health.

As for congenital malformations and the diseases arising directly from the state of infancy, statistics show that together they rank eighth among all causes of death. Half the total number of infants who die under one year of age die under one month of age. Such deaths are due chiefly to prenatal damage which caused faulty skeletal development, general weakness, or specific physiologic weaknesses inconsistent

with life. Some of these are cited in Table 5. Again, the condition of the mother is thought to be an important causative factor, although the specific cause of defective development cannot always be determined.

The Mother

How Does the Health of the Mother Affect the Child? The matter of diet is of first importance during pregnancy, for growth of the child cannot take place normally unless the materials for growth—all of them—are provided in due amount.

Second, any infection of the mother during pregnancy must be considered as a potential danger to the child. Although most bacteria except those of syphilis do not pass through the placenta and thus do not actually infect the child, toxins from bacteria are not thus barred, and may even cause death of the child *in utero*.

Third, poisons present in the mother's blood may pass into the child's. In certain industrial occupations, poisons (e.g., lead) are a major hazard to the unborn child. In other circumstances, perhaps the greatest danger comes through self-medication—always unsafe, but especially so during pregnancy. Many authorities believe that alcohol in the blood at the time of conception has a harmful effect upon the germ cells, and is thereby responsible for general debility of the child. As for nicotine poisoning of the child through the mother's smoking, many obstetricians believe it to be a possibility.

Fourth, mechanical injury of the mother may cause death or injury of the child, although it is normally well-protected by the fluid in the amniotic sac that surrounds it.

Fifth, overfatigue undeniably is detrimental to both mother and child. In some states laws have been passed limiting the hours of work of pregnant women and barring them from work during the last three months.

It should be noted that the mother cannot "mark" the child by anything she looks at, touches, hears, or thinks about. There is no mechanism whereby "maternal impressions" could possibly be registered upon the child. Birthmarks and the various developmental defects such as cleft palate and harelip appear early in prenatal life. Some are due to heredity and others to disease or malnutrition of the embryo.

What Prenatal Care Should the Mother Receive? In cities the prospective mother consults a physician at about the middle of pregnancy in about 50 per cent of cases. It would be vastly better for both mother

and child if the first medical consultation were to occur when pregnancy is first suspected.

Prenatal care involves, first, a general examination, and then specific examinations concerning the pregnancy itself. Specific advice is given, appropriate to the individual in question. Throughout a pregnancy that is proceeding normally, the physician usually requests the mother to report once a month during the first six months, twice a month during the seventh and eighth months, and weekly during the last month.

There are several rather common disorders of pregnancy that may be fatal if neglected. Among these may be mentioned a condition known as toxemia of pregnancy. It involves the kidneys and the disturbance usually is first shown by changes in the urine and the blood pressure. For this reason these two tests must be made frequently during pregnancy.

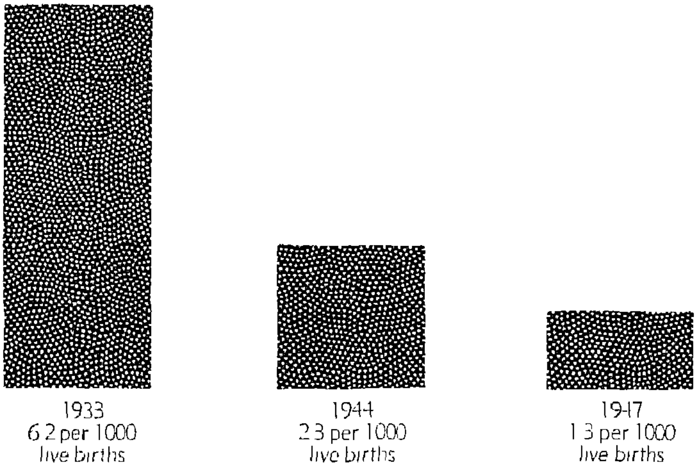
Practically all of the complications of pregnancy can usually be averted if the mother places herself in competent medical hands and implicitly follows advice.

Competent medical care means either a general practitioner of medicine who has had large experience in obstetrics and whose work in this field is respected by his fellow physicians and leading individuals in the community, or an obstetrician, a specialist in obstetrics certified by the American Board of Specialists in Obstetrics and Gynecology. (The names of individuals are to be found in the Directory of Specialists or the Directory of the American Medical Association, both to be found in public libraries.)

Safe Childbirth for the Mother. Among the states in this country the rate of maternal mortality varies widely, with an average of 13 per 10,000 live births in 1947.

In the states having the best rates, nearly all births are attended by physicians; and in the worst, only about three fourths. Similarly, in the states with the best records, a high percentage of deliveries are in hospitals, and in those with the worst records, a small percentage. These facts do not imply that delivery cannot safely take place at home, but suggest that the facilities of a hospital offer certain important advantages over the average home equipment.

One of the dangers to the mother is puerperal fever, or infection of the birth tract during the lying-in period. Dr. Oliver Wendell Holmes, the physician-poet, was the first to affirm (in 1843) that this disease is an infection. The first clinical work attacking this disease was done



Decline of maternal mortality rates in United States.

by Semmelweiss at the Vienna Hospital in 1846–1847. The disease was then extremely prevalent. In one outbreak, one mother in every six died of it. Semmelweiss ordered that the hands of all those entering the delivery room be washed in a solution of chlorinated lime, and in a few months the maternal death rate dropped from 12.4 per cent to 3.04 per cent. After the discovery of bacteria and the adoption of aseptic technic for excluding bacteria from hands, instruments, and materials used in delivery rooms and operating rooms, the rate dropped still lower. It is now a small fraction of 1 per cent in normal deliveries at term (although it is higher in miscarriages, and very much higher in circumstances of illegal induction).

Similar although less spectacular decreases have occurred also in other maternal complications of childbirth, such as hemorrhage. In fact, complications are now rare in those who have good care both before and during delivery.

The Child

Safe Birth for the Child. In the hands of a competent physician, birth ordinarily is not a particularly hazardous time for a child.

The most serious danger to the child arises from mechanical difficulties in delivery. Frequently there is a disparity between the size of the child and the outlet through which it must pass. This difficulty can usually be forestalled by prenatal examinations and preparations before labor begins. Sometimes it is solved by delivering the child

through an incision in the abdominal wall (Cesarean operation), if the pelvic outlet is very narrow and the child large; or, more commonly, by using forceps to exert traction at the time of labor.

Also, the position of the child as it advances toward birth may be disadvantageous to easy birth (e.g., breech presentation, i.e., hips first). Such conditions call for special obstetrical skill, in the absence of which accidents may happen.

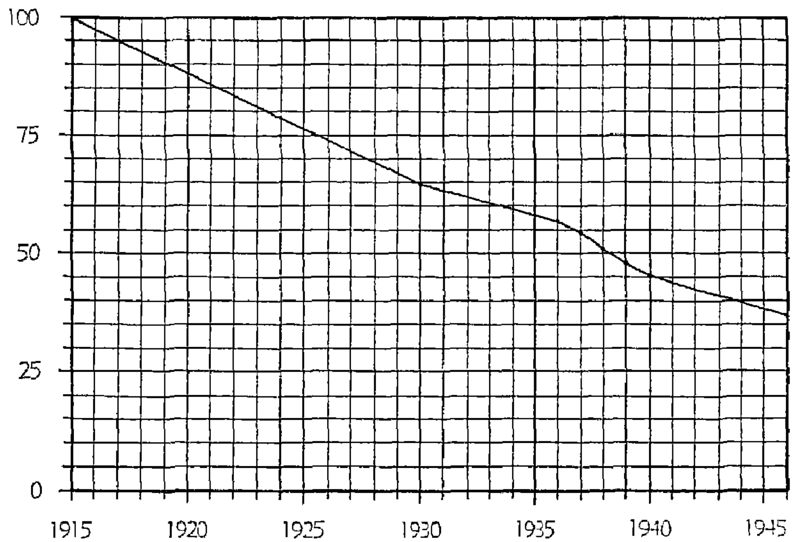
Dangers also arise in respect to breathing just after birth; often the child requires expert assistance in inflating the lungs for the first time.

It will be recalled that incompatibility in respect to the Rh factor in the blood of the mother and father may lead to damage of the child before or immediately after birth, unless the danger is forestalled by tests during pregnancy, followed by appropriate treatment then or at the time of delivery.

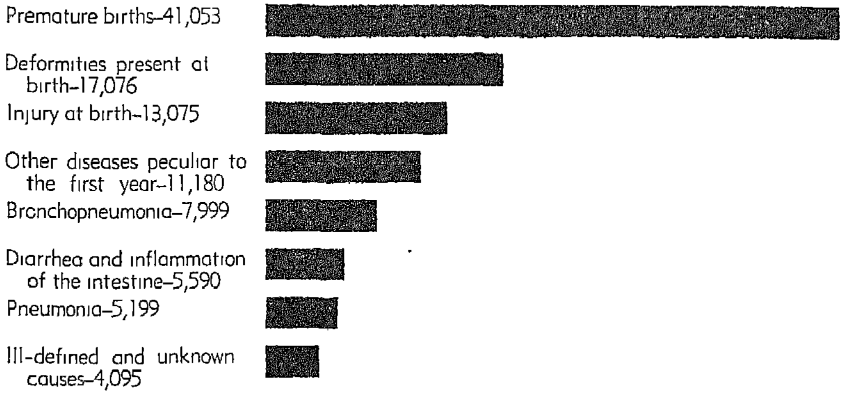
Obviously, although birth is a natural process, it cannot safely be left entirely to nature.

Hazards of the First Year of Life. The first year of life is the most hazardous of all. As shown in Table 2 the highest death rate occurs under one year of age. From one to 10 there is a steady decline, and after 11 a steady rise, but the infant level is not reached again until nearly 70.

However, the infant mortality rate (deaths of infants from birth to



Decline of infant mortality in the United States per 1000 live births 1915–45.



Total number of infant deaths for specific causes in the United States for 1947.

one year of age per 1000 born alive) has greatly decreased in this century in the United States. In 1900, in eight large cities throughout the country, of every 100 babies born alive, 30 to 40 died before their first birthday, as contrasted with 3.7 today in this country as a whole. In other words, nearly 97 per cent of babies now born alive will survive the first hazardous year.

The improvement in the infant death rate is due chiefly to better control over the communicable diseases, many of which are, or were, particularly prevalent in babies. The great decline in the total death rate from eight of these diseases is shown above. The few communicable diseases that remain large causes of infant deaths are shown on p. 46.

Although improvement has taken place in mortality from causes acting before birth, these are now the most important causes of infant mortality. It should be noted that prematurity is by far the most frequent cause of infant deaths.

Making the First Year of Life Safe. It is obvious that better care of mothers before and at birth is a primary essential if more infant lives are to be saved.

As for prematurity, the possibility of improvement lies chiefly in suitable care immediately after birth. Special apparatus usually is necessary, such as incubators and oxygen tanks, and specially trained nurses must be in charge. Such facilities are not available in all communities. If they were, many infant lives could be saved, for the child born after even as short a time as six months of intrauterine life may, with good care, survive and become normally healthy.

As for the infections that are still responsible for the death of many

babies, they often have their starting point in the ill health of the parents or members of the household. Against one of these infections, syphilis, the child could be protected by treatment of the mother before conception or during early pregnancy. Against another, tuberculosis, the child could be greatly protected by preventing its contact with a tuberculous mother or tuberculous members of its own household. Two—bronchitis

Child being examined at the New York, Kips Bay Yorkville Health Center, one of 67 Child Health Stations in the city. (Courtesy, U.S. Public Health Service.)

and bronchopneumonia; and influenza and pneumonia—are respiratory infections acquired by the child through direct or indirect contact with infected persons—and again, such contacts most often take place within the household in the case of young children, and usually could have been prevented.

Two other infections—whooping cough and diphtheria—are preventable by specific inoculations.

The diseases known as diarrhea and enteritis are in a somewhat different category. Usually they occur as the combined results of faulty hygiene of the child plus infection carried by food. The decline in

the rate of deaths from these ailments began at about the turn of the century, when the new bacteriologic standards for milk first began to be applied, by (1) purification of the public milk supply, and (2) education of mothers in the care of milk in the home and in the preparation of infant feedings. The name of Nathan Straus of New York stands out as the founder of the first Baby Milk Station from which pasteurized milk was distributed. The Children's Bureau of the U.S. Department of Labor has promoted infant welfare work throughout the country in many ways, one of which is the circulation of free pamphlets on all phases of the care and feeding of infants.

Years ago it was thought that a high infant death rate was inevitable owing to the natural feebleness of the newborn child. Now it is believed that the large majority of infants can be born strong enough to survive, and with due parental care and protection *will* survive. The next generation will be what this generation makes of itself and its young.

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Pamphlets

Pamphlets are available either free or at small cost from many of the national organizations named on page 15, and from the American Medical Association, the United States Public Health Service, numerous departments and divisions of the Federal Government, and the various state departments of health.

Journals

American Journal of Public Health. Published monthly by the American Public Health Association, 1790 Broadway, New York City.

Hygeia, the Health Magazine. For laymen. Published monthly by the American Medical Association, 535 North Dearborn Street, Chicago 10, Illinois.

Mental Hygiene. Published quarterly by the National Committee for Mental Hygiene, 1790 Broadway, New York City.

Library

The National Health Library is maintained by the National Health Council, at 1790 Broadway, New York City. Its facilities are available to members of constituent organizations, as given on page 15 ff. Those who are not members of the constituent organizations may share its privileges under certain conditions.

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